Mike Gottwald
58-558 X7478

TEKTRONIX®

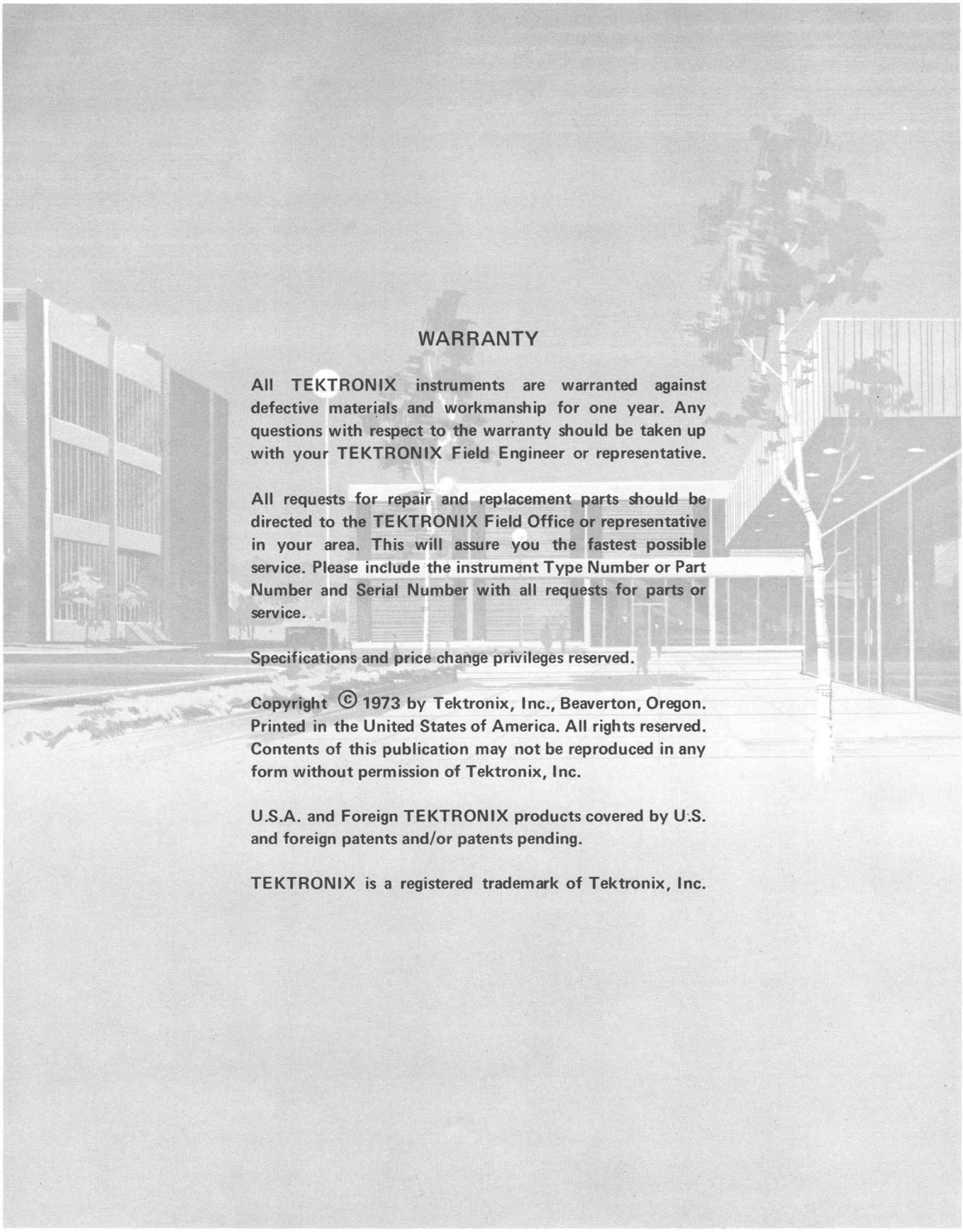
148
INSERTION TEST SIGNAL GENERATOR

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97005

Serial Number _____

070-1266-00



WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repair and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

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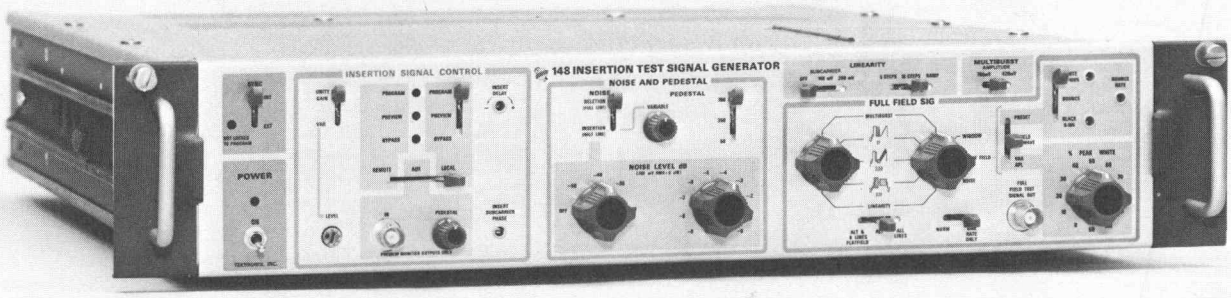


Fig. 1-1. The 148 Insertion Test Signal Generator.

SECTION 1
SPECIFICATION

General Information

The 148 is a PAL (Phase Alternate Line) television test signal generator capable of supplying several test signals commonly used for test and measurement of video transmission systems or discrete parts of the system. The generated signals are available as full-field composite video test signals on one output, and as Insertion Test Signals inserted into the vertical blanking interval of an incoming composite video signal, appearing in combined form on another output.

In addition to the front-panel controls, there are extensive provisions within the instrument to permit selection of the test signal parameters and their time location within the vertical blanking interval. This flexibility is provided mainly through the use of pin connector changes, permitting simple and rapid change of selection without soldering procedures. All time locations of test signals, both as to position within the line and field, are derived by digital counting from a master oscillator which, in turn, is locked to the incoming synchronizing pulses. The 148 may be used in conjunction with the TEKTRONIX Type 141A to provide standard test signals with Gen-Locked[1] operation.

Several different test signals may be inserted on successive lines during the vertical blanking interval, providing a simultaneous check of the complete television transmission system.

[1] **Synchronization of signals in both frequency and phase.**

A Preview mode of operation permits observing the signal with insertion signals added before adding to the program signal.

In the event of power failure, or the actuation of a remote bypass switch, a relay switch routes the program signal around the instrument, bypassing all circuitry and thus providing fail-safe protection.

Safety Considerations

The instrument is intended to be operated from a single-phase power source which has one of its current-carrying conductors (neutral) at or near ground (earth) potential. Operation from other power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a multi-phase system) is not recommended, as only the Line Conductor has over-current (fuse) protection within the instrument.

ELECTRICAL CHARACTERISTICS

Performance Conditions

Characteristics and their Performance Requirements described in this section are valid over the stated environmental range, for instruments calibrated at an ambient temperature between +20°C and +30°C. Instrument warm-up of five (5) minutes is required.

TABLE 1-1

INSERTION CONTROL SYSTEM

Characteristic	Performance Requirement	Supplemental Information
Signal Input Level		
UNITY GAIN	Within 0.5% of Unity Gain	
VAR	1 V P-P within 30%	
Input Impedance		75 Ω nominal
Input Return Loss		
POWER ON	At least 30 dB to 7 MHz	
POWER OFF or BYPASS	At least 30 dB to 7 MHz	

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Output Impedance (all)		75 Ω nominal
Output Return Loss (all)	At least 30 dB to 7 MHz	
Output Blanking DC Level (all)	0 volts within 50 mV	
Isolation		
PROGRAM & PREVIEW OUT		At least 46 dB to 1 MHz At least 34 dB to 4.43 MHz
PROGRAM & PROGRAM MONITOR OUT		At least 46 dB to 1 MHz At least 34 dB to 4.43 MHz
Inserted Signal Amplitude	Within 1% of nominal	
Amplitude Ratio		
2T Pulse to Bar	100% within 0.25%	
Mod Sin^2 Pulse	100% within 0.5%	Chrominance to Luminance
Waveform Tilt		
Line Tilt	0.25% or less	
Field Rate Square Wave	0.5% or less	
Differential Phase (10-90 APL, Standard Input)		
Program Output	0.15° or less	0.3° or less at +3 dB
Preview Output	0.3° or less	
Differential Gain (10-90 APL, Standard Input)		
Program Output	0.2% or less	0.4% or less at +3 dB
Preview Output	0.4% or less	
Luminance Amplitude Non-Linearity	0.25% or less	Unmodulated Staircase
Random Noise Output		
Program Output	At least 75 dB (RMS) down	Using weighted and Low Pass filters (5 MHz)
Residual Subcarrier On Non-Inserted Lines	At least 60 dB down	4.43 MHz Bandpass Filter
Hum or Transients On Non-Inserted Lines	At least 60 dB down	Low Pass (5 MHz)

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Spurious Signals During Blanking	At least 40 dB down	Low Pass (5 MHz)
Active picture, ITS Lines	At least 60 dB down	Low Pass (5 MHz)
Signal Attenuation in "Delete" Mode		
2T Pulse	At least 70 dB	Low Pass (5 MHz)
Subcarrier (colour bars)	At least 60 dB	Low Pass (5 MHz)
Crosstalk Into Program Channel From Internal Signal		
2T Pulse	At least 70 dB down	Low Pass (5 MHz)
Subcarrier (staircase)	At least 60 dB down	Low Pass (5 MHz)
INSERT DELAY Range	At least + and − 0.5 μs (1 μs total)	
Time Jitter		5 ns or less
Frequency Response	Within 1% to 6 MHz; +1 to −6.5% from 6 MHz to 10 MHz	
Unwanted Pedestal at Time of Test Signal Insertion	5 mV or less	
Subcarrier Lock		
Pull-In Amplitude	Requires 150 mV or more of burst to lock	
Hold-In Amplitude	Once locked, it will remain locked with 50 mV or more of burst	

TABLE 1-2

TEST SIGNAL ELEMENTS

Characteristic	Performance Requirement	Supplemental Information
MULTIBURST Signal		
White Ref Amplitude (700 mV)	700 mV within 1%	
White Ref Amplitude (420 mV)	420 mV within 1%	
Burst Amplitude		
700 mV Level	700 mV within 1%	
420 mV Level	420 mV within 1%	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Average Level		
700 mV	350 mV within 5 mV	
420 mV	350 mV within 5 mV	
Burst Frequencies	0.5 MHz within 3%	
	1.0 MHz within 3%	
	2.0 MHz within 3%	Adjustable range to at least 2.8 MHz
	4.0 MHz within 3%	Adjustable range to at least 4.43 MHz
	4.8 MHz within 3%	
	5.8 MHz within 2%	
Burst Harmonic Content	–40 dB	
Burst Timing	Each burst starts at 0° and consists of a whole number of cycles	
LINEARITY Signal		
Staircase Signal		
Luminance		
Amplitude		
10 Step	700 mV within 1%	
5 Step	700 mV within 1%	
Riser		
5 and 10	Amplitude of each riser is within 1%	
Risetime (All Identical)	≈230 ns within 15%	Determined by 2T Sin^2 filter having first zero at 4.43 MHz
Chrominance		
Frequency		
Free Run	4.43361875 MHz within 25 Hz	
Locked Mode	Locked to incoming burst or external subcarrier	
OFF	No subcarrier	
140 mV	140 mV within 1%	
280 mV	280 mV within 1%	
Inherent Differential Gain	0.5% or less	
Inherent Differential Phase	0.2° or less	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Envelope Rise and Fall Times	≈ 375 ns	
Phase	60°, + and –5° to B-Y AXIS	
Timing	Waveform transitions determined by characteristic instants (see Fig. 1-2)	
Ramp Signal		
Amplitude	700 mV within 1%	Deviation from straight line at any point ⩽ 1% of the ordinate at that point
Linearity	Within 1%	
Timing	See Fig. 1-2	
SIN^2 PULSE; 2T or T, and Integrated Sin^2 Pulse (Bar) 2T or T Signal		2T pulse, 2T Bar Factory programmed
Pulse		
Pulse to Bar Ratio	0.99 to 1.01	
Half Amplitude Duration	200 ns (2T); 100 ns (T)	Determined by 9 Pole Kastelein[2] Filter
Ringing Amplitude	0.5% or less	
Ringing Duration		2 cycles or less (determined)
Timing	See Fig. 1-2	
Luminance		
Bar		
Risetime	200 ns (2T); 100 ns (T)	
Amplitude	700 mV within 1%	
Timing	See Fig. 1-2	
Tilt	0.5% or less, 10 μs period	
Modulated Sin^2 Pulse	20 T	Other pulses available by plug-in filter
Amplitude of Luminance Component	350 mV within 1% of the Luminance Bar Amplitude	
Amplitude Difference of Peak Chrominance to Peak Luminance	3.5 mV or less	

[2] A. Kastelein, "A NEW SINE-SQUARED PULSE AND BAR-SHAPING NETWORK", IEEE Transactions of Broadcasting, Volume BC-16, Number 4, DEC. 1970 (pp 84-89).

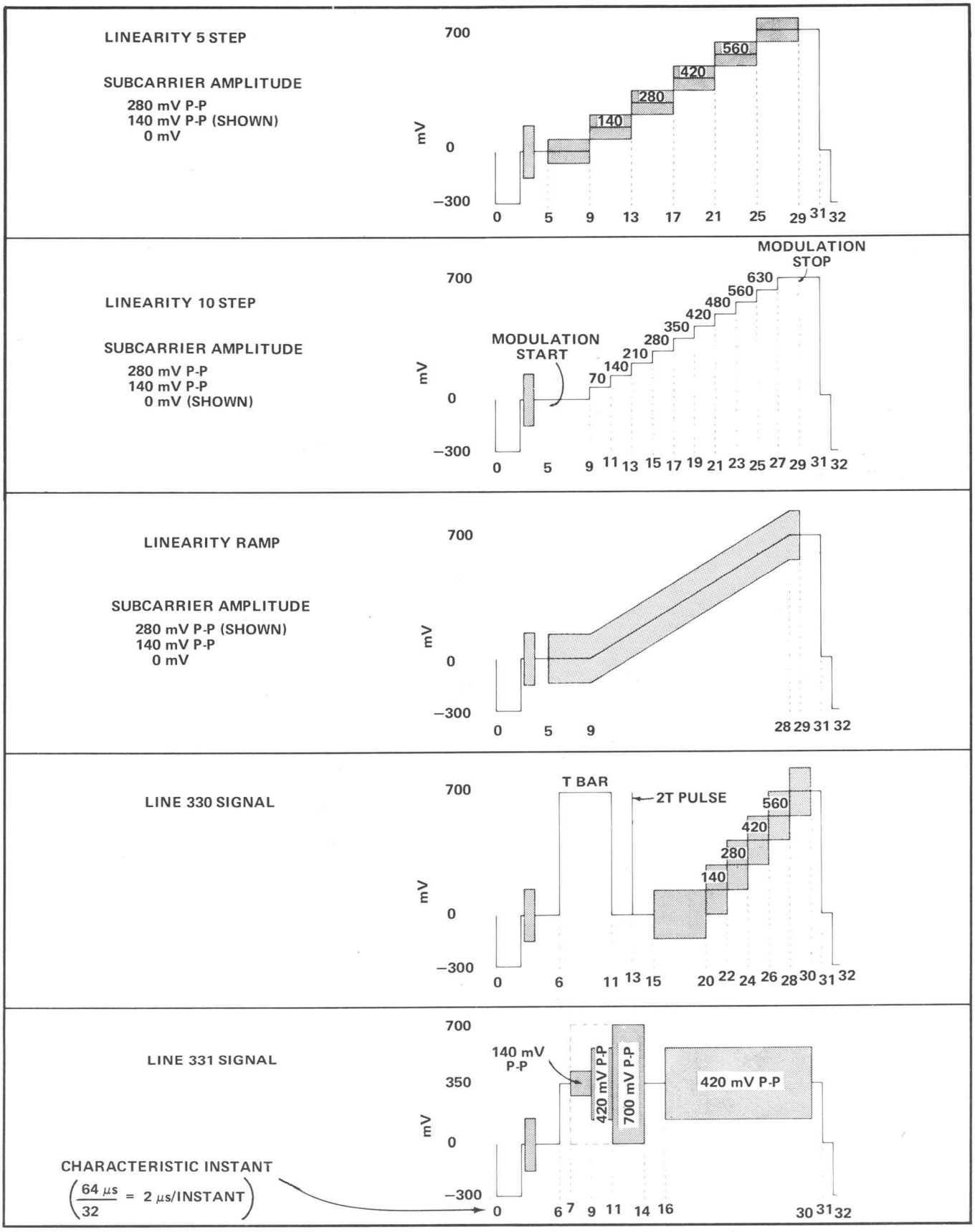
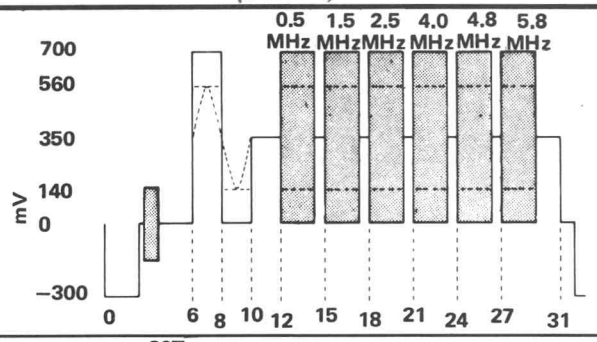


Fig. 1-2. Test signal output timing details.

LINE 18 SIGNAL (MULTIBURST)

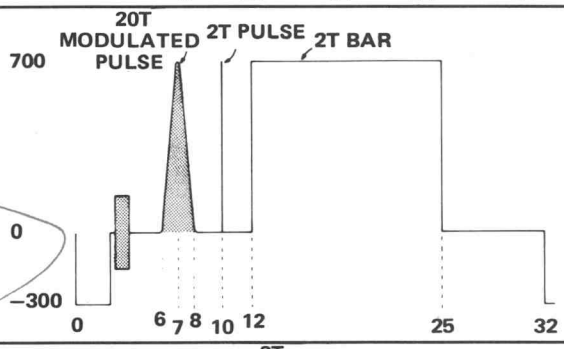
BURST AMPLITUDES: 700 mV P-P or 420 mV P-P



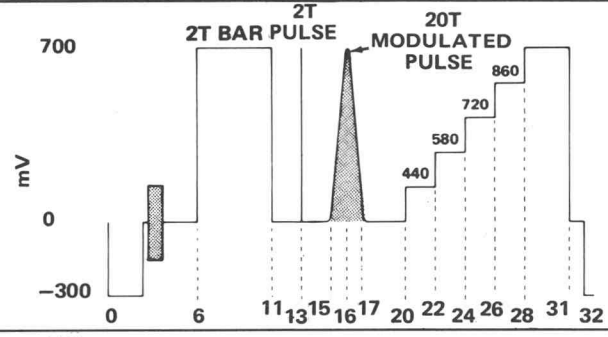
WINDOW OR PULSE AND BAR (2T BAR)

NOTE:

BAR PORTION OF WINDOW SIGNAL BETWEEN LINES 65 AND 270 ONLY



LINE 17 SIGNAL



FIELD SQUARE WAVE
OR
FLAT FIELD

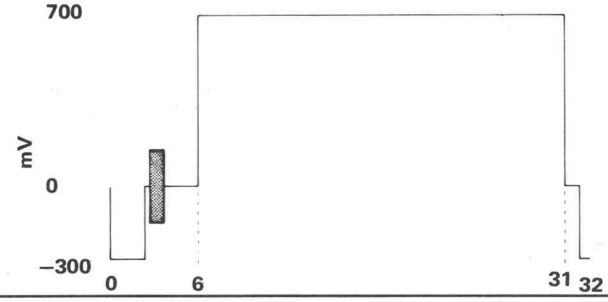
NOTES:

1: BLACK (0 mV) BEFORE LINE 65 AND AFTER LINE 270 FOR FIELD SQUARE WAVE.

2: VARIABLE AMPLITUDES: 0, 70, 140, 210, 280, 350, 420, 490, 560, 630, OR 700 mV.

3: PRESET BLACK; 0 TO 105 mV.

4. PRESET WHITE; 595 TO 700 mV.



NOISE AT PREVIEW OUT IN INSERTION MODE

NOISE AT PREVIEW & FULL FIELD OUTPUTS IN DELETION MODE

NOISE AT FULL FIELD OUT IN INSERTION MODE INTERNALLY GENERATED

CHARACTERISTIC INSTANT

$\left(\frac{64\ \mu s}{32} = 2\ \mu s/\text{INSTANT}\right)$

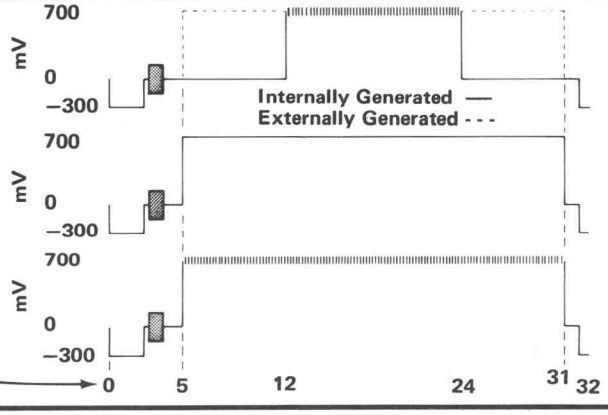


Fig. 1-2 (cont). Test signal output timing details.

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Chrominance-Luminance Delay	10 ns or less	Measured from baseline
HAD (Half Amplitude Duration) of 20T	2.0 μs within 0.06 μs	
Residual Subcarrier on Insertion Line	3.5 mV or less	
Harmonic Content of Subcarrier	–40 dB	
Phase		
Insertion and FULL FIELD	60°	Adjustable to any phase
WINDOW Signal		
Amplitude	Same as Bar	
Risetime	Same as Bar	
Duration	26 μs/line X 152 lines	Lines 65 through 270; lines 377.5 through 582.5
Chrominance Bar		
Amplitude	Within 1% of the Luminance Bar	
Pedestal	350 mV within 1%	
Chrominance/Luminance Cross Modulation	$\leqslant$ 0.5% of pedestal amplitude	
Envelope Risetime	$\approx$ 1 μs	
Timing	See Fig. 1-2	
Three Level Chrominance Bar		Determined by 9 Pole Kastelein[2] Filter
Timing	See Fig. 1-2	
Amplitude (peak-to-peak)		
1st	Within 1% of 1/5 of the Luminance Bar	140 mV, nominal
2nd	Within 1% of 3/5 of the Luminance Bar	420 mV, nominal
3rd	Within 1% of the Luminance Bar	700 mV, nominal
Pedestal	350 mV within 1%	
Chrominance Reference		
Chrominance/Luminance Cross Modulation	Less than 0.5% of pedestal amplitude	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Envelope Risetime	≈ 1 μs	
Amplitude (peak-to-peak)	420 mV within 1% of the Luminance Bar amplitude	± 7 mV
Pedestal	350 mV within 1%	
Envelope Risetime	≈ 1 μs	Determined by 9 Pole Kastelein[2] Filter
Identification Code		
Line	16 or 329 or both	
Number of Pulses Available		Up to 25, any combination
Pulse Width	1 μs within 0.1 μs	
Risetime		Determined by 2T filter
Pulse Timing	Start of rise on any characteristic instant from 6 through 30	
"One" Level	630 to 700 mV above the blanking level	
"Zero" Level	Within ± 25 mV of the blanking level	
FLAT FIELD Signal		
WHITE	85 to 100% of peak white	Adjustable
BOUNCE	Automatic bounce between white and black	
RATE	≈1 second to greater than 10 seconds	
BLACK	0 to 15% of peak white	Adjustable
VARIABLE	11 levels, each within 0.5% of nominal level	
Risetime	≈230 ns	
Time Location	See Fig. 1-2	Active portion of Line
FIELD SQ WAVE Signal		
Amplitude	700 mV within 1%	
Lines White	Lines 65 through 270; lines 377.5 through 582.5	
Lines at Blanking	All other active lines	
Risetime	230 ns within 15%	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
NOISE		
Noise Measurement Signals		
Pedestal Amplitude		
50 mV	50 mV within 5 mV	50 mV nominal
350 mV	350 mV within 2%	350 mV nominal
700 mV	700 mV within 2%	700 mV nominal
Variable Pedestal Range (Insertion Mode Only)	+7 mV to –7 mV from nominal	
Noise Amplitude	–20 dB to –59 dB (0 dB = 700 mV RMS)	Low Pass (5 MHz)
Noise Attenuators		
Absolute Amplitude	Within 1 dB	
Noise Spectrum		
FLAT Energy/Unit	15 kHz to 5 MHz, flat within 6 dB	
Output Impedance		75 Ω (nominal)
Output Return Loss	At least 30 dB to 7 MHz	

TABLE 1-3

FULL FIELD OUTPUT

Characteristic	Performance Requirement	Supplemental Information
Full Field Test Signal Outputs		
Amplitude Relative to Inserted Signals of Same Type	Within 1% (both outputs)	
Return Loss	At least 30 dB to 7 MHz	
Full Field Noise Measurement Signal	Same as Noise Measurement (see TEST SIGNAL ELEMENTS) except when NOISE switch is in INSERTION position; Noise and Pedestal are full duration instead of 1/2 Line.	
Sync and Burst Timing	See Fig. 1-3 and 1-4	
Sync Amplitude	300 mV within 1%	
Burst Amplitude	300 mV within 1%	

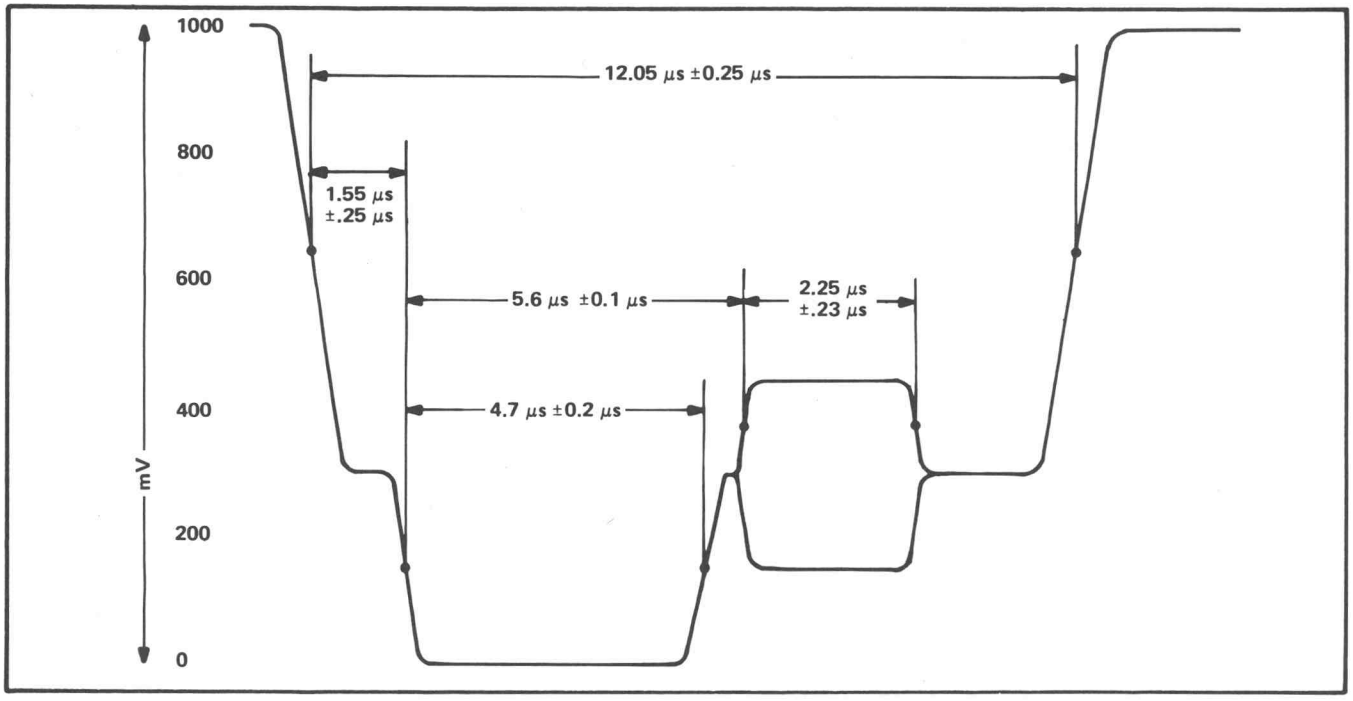


Fig. 1-3. Line synchronizing details.

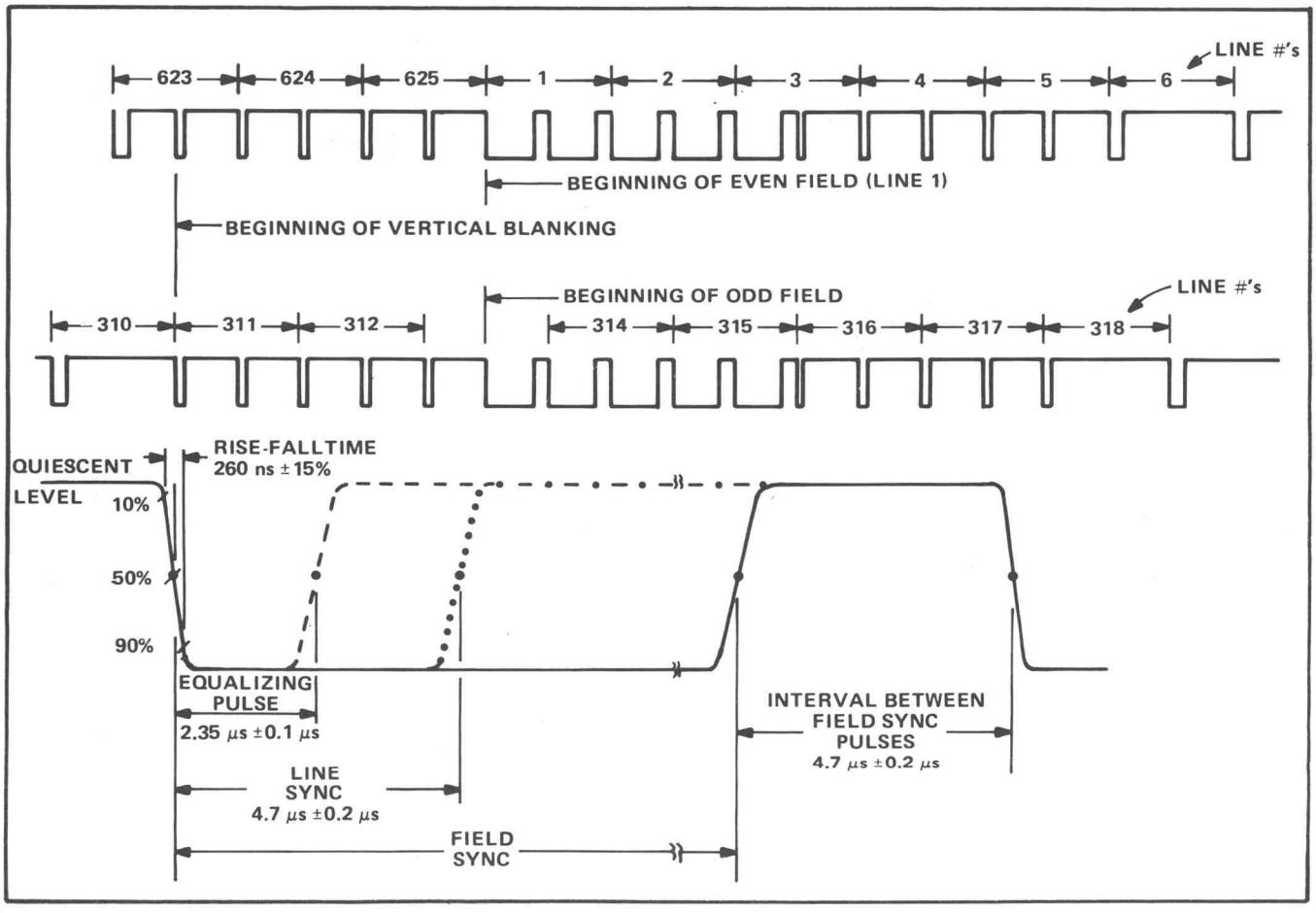


Fig. 1-4. Field synchronizing details.

TABLE 1-4

OTHER SIGNAL OUTPUTS AND INPUTS

Characteristic	Performance Requirements	Supplemental Information
Outputs		Terminated in 75 Ω
CW SUBCARRIER	2 V P-P within 20%	
COMPOSITE SYNC	4 V P-P within 10%	
NOISE	70 mV RMS	Low Pass (5 MHz)
Inputs		
COMPOSITE SYNC		
Amplitude	2 V nominal	
Return Loss	30 dB to 5 MHz using external 75 Ω termination	
BURST FLAG		
Amplitude	2 V nominal	
Return Loss	30 dB to 5 MHz using external 75 Ω termination	
PAL PULSE		
Amplitude	2 V nominal	
Return Loss	30 dB to 5 MHz using external 75 Ω termination	
4.43 MHz		
Amplitude	2 V nominal	
Return Loss	30 dB to 5 MHz using external 75 Ω termination	
EXT ITS IN		
Level	2 V nominal	
Return Loss	30 dB to 5 MHz using external 75 Ω termination	

TABLE 1-5

POWER SUPPLY

Characteristic	Performance Requirements	Supplemental Information
Line Voltage Range		
115 VAC Low		90 V to 110 V
115 VAC Medium	104 V to 126 V	
115 VAC High		112 V to 136 V
230 VAC Low		180 V to 220 V
230 VAC Medium		208 V to 252 V
230 VAC High		224 V to 272 V
Crest Factor		At least 1.35
Maximum Line Current	0.5 A	
Maximum Power Consumption	55 W	
Line Frequency Range	48 to 66 Hz	

TABLE 1-6

Physical

Characteristic	Information	
Finish	Cabinet is blue-vinyl painted. Front panel is anodized aluminum.	
Dimensions	**Rackmount**	**Bench Model**
Overall		
Height	3.47 inches	3.82 inches
Width	19.0 inches	18.225 inches
Length	19.66 inches	19.1 inches
Cabinet		
Height		3.47 inches
Width	16.88 inches	17.1 inches
Length	18.41 inches	18.41 inches
Width Over Sides	17.625 inches	
Length with BNC-T	18.6 inches[3]	18.91 inches[4]

[3] **18.67 inches with BNC Cable to Connector.**

[4] **18.98 inches with BNC Cable to Connector.**

ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local TEKTRONIX Field Office or representative.

ACCESSORIES

Standard accessories supplied with this instrument are listed in the Mechanical Parts List.

TABLE 1-7

ENVIRONMENTAL

Characteristic	Information
Temperature	
Non-Operating Range	–40°C to +65°C
Operating Range	0°C to +50°C
Altitude	
Non-Operating Range	To 50,000 feet
Operating Range	To 15,000 feet

SECTION 2
OPERATING INSTRUCTIONS

General

This section of the manual is intended to provide the operator with information necessary for proper operation of the 148. Included are (1) Initial Installation information dealing with the various line voltages that may be used to power the instrument, and information regarding Local or Remote operation; (2) Controls and Connectors, a brief discussion of each control and connector; (3) Basic Information, dealing with the different signals generated by the 148 and how they might be used; (4) First Time Operation, a complete step-by-step procedure using each control and connector; (5) Operating Changes, dealing with all internal changes that can be made for different applications; and (6) Glossary of Terms.

We recommend that the user of this instrument refer to the following reference material as a supplementary source of information.

Television Products Application Notes, Tektronix, Inc.

INSTALLATION

Operating Voltage

WARNING

The instrument is intended to be operated from a single-phase power source which has one of its current carrying conductors (The Neutral Conductor) at or near ground (earth) potential. Operation from other power sources where both current carrying conductors are live with respect to ground (such as phase-to-phase on multi-phase systems) is not recommended, as only the Line Conductor has over-current (fuse) protection within the instrument.

The 148 may be operated from either 115-VAC or 230-VAC (nominal) line voltage source. Quick-change line-voltage plugs, located under the fuse cover on the rear panel, change the transformer primary connections so that the instrument will operate from one line voltage or the other (115 V or 230 V). In addition, the plugs permit one of three line voltage operating ranges to be selected. Table 2-1 lists the voltage ranges that enable the instrument DC power supplies to regulate properly.

TABLE 2-1

115/230 Voltage Selector Plug Position	Range Selector Plug Position	Nominal Line (Center) Voltage	Line Voltage Plug Range[1]
115 V	LO (Low)	100 VAC	90 to 110 VAC
	M (Medium)	115 VAC	104 to 126 VAC
	HI (High)	124 VAC	112 to 136 VAC
230 V	LO (Low)	200 VAC	180 to 220 VAC
	M (Medium)	230 VAC	208 to 252 VAC
	HI (High)	248 VAC	224 to 272 VAC

[1] **Applicable when the line contains less than 2% total distortion.**

To convert to a different line voltage, proceed as follows:

1. Disconnect the 148 from the power source.

2. Unscrew the two captive screws holding the fuse cover. Remove the cover and attached fuses.

3. Pull out the 115/230 Voltage Selector plug, see Fig. 2-1, then rotate the plug 180° and insert it into the opposite set of holes. The 115/230 Voltage Selector plug is located in the upper position for 115 V operation, and in the lower position for 230 V operation.

4. To change the line-voltage operating range (LO, M, or HI), pull out the Range Selector plug and insert it in the desired hole locations. Select a range with a center voltage (see column three in Table 2-1) closely corresponding to the line voltage that will be applied in regular instrument operation.

5. Re-install the cover with the two captive screws and fuses. Be sure the cover fits firmly against the rear panel.

This indicates that the line fuses are seated properly in the fuse clips.

6. Before applying power to the instrument, check that the indicating tabs on the selector plugs protrude through the proper holes in the cover for the correct line voltage and the proper operating range.

CAUTION

The 148 should not be operated with the 115/230 Voltage Selector and/or Range Selector plugs in the wrong position for the line voltage applied.

Local-Remote Connector

The 148 may be operated by local or remote means. (Local means 148 operation from the front panel.) A multi-pin connector, REMOTE J9014 is incorporated on the rear panel, see Fig. 2-1. Installed to this is a REMOTE plug, P9014, TEKTRONIX Part No. 131-0325-00. This plug is factory wired for LOCAL operation, see Fig. 2-2.

To operate Remote, separate switching must be used at the remote location(s). In addition, the multi-pin plug must be wired accordingly. Fig. 2-3 shows the external switching required for remote control of FULL FIELD, PROGRAM, and PROGRAM LINE OUT FULL FIELD BYPASS. The external switching may be separate or combined to be

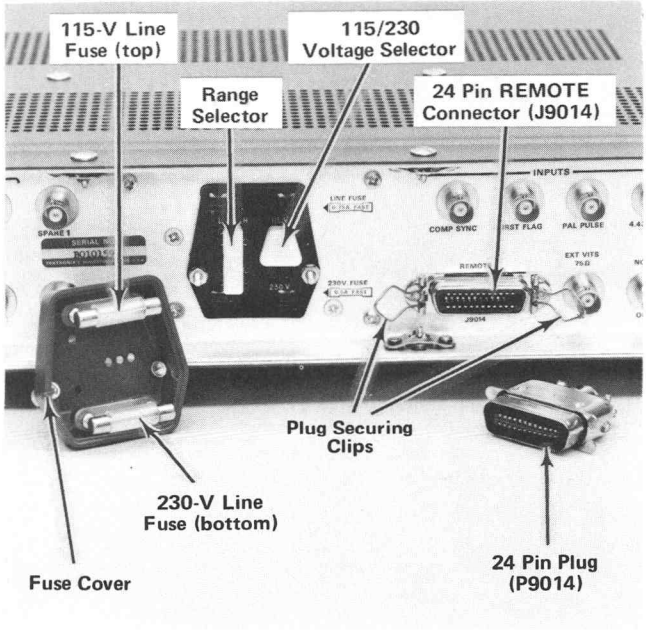


Fig. 2-1. Location of Range and Voltage Selector plugs with fuse cover removed (plugs as shown are set for 115-V medium range operation). Also shown is the REMOTE (J9014) connector, Plug (J9014), and plug securing clips.

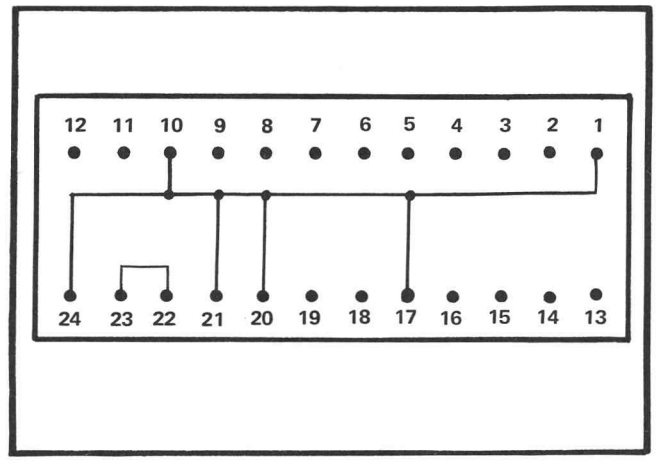


Fig. 2-2. Wiring diagram of Remote Plug for LOCAL operation (factory connected).

controlled by one operator. Once the necessary wiring is complete, reconnect the plug to the REMOTE connector (J9014) and lock into place with the two securing clips.

CONTROLS AND CONNECTORS

Introduction

The following describes the function or operation of the 148 controls and connectors. Refer to Fig. 2-4 for locations of the controls and connectors.

Front-Panel Controls

POWER	Toggle switch to turn instrument power ON and OFF. Lamp indicates when POWER switch is ON and the instrument is connected to a line voltage source.
FREE RUNNING MODE	Lamp indicates absence of incoming synchronizing information (e.g., no externally applied composite video or black burst). In this state, no Insertion Test Signals are added. Full Field signals are generated, but subcarrier free runs at approximately 4.43 MHz; line and field sync are mutually coherent, but not with subcarrier.
SYNC	Selects source of timing information.
INT	Timing derived from incoming program signal.

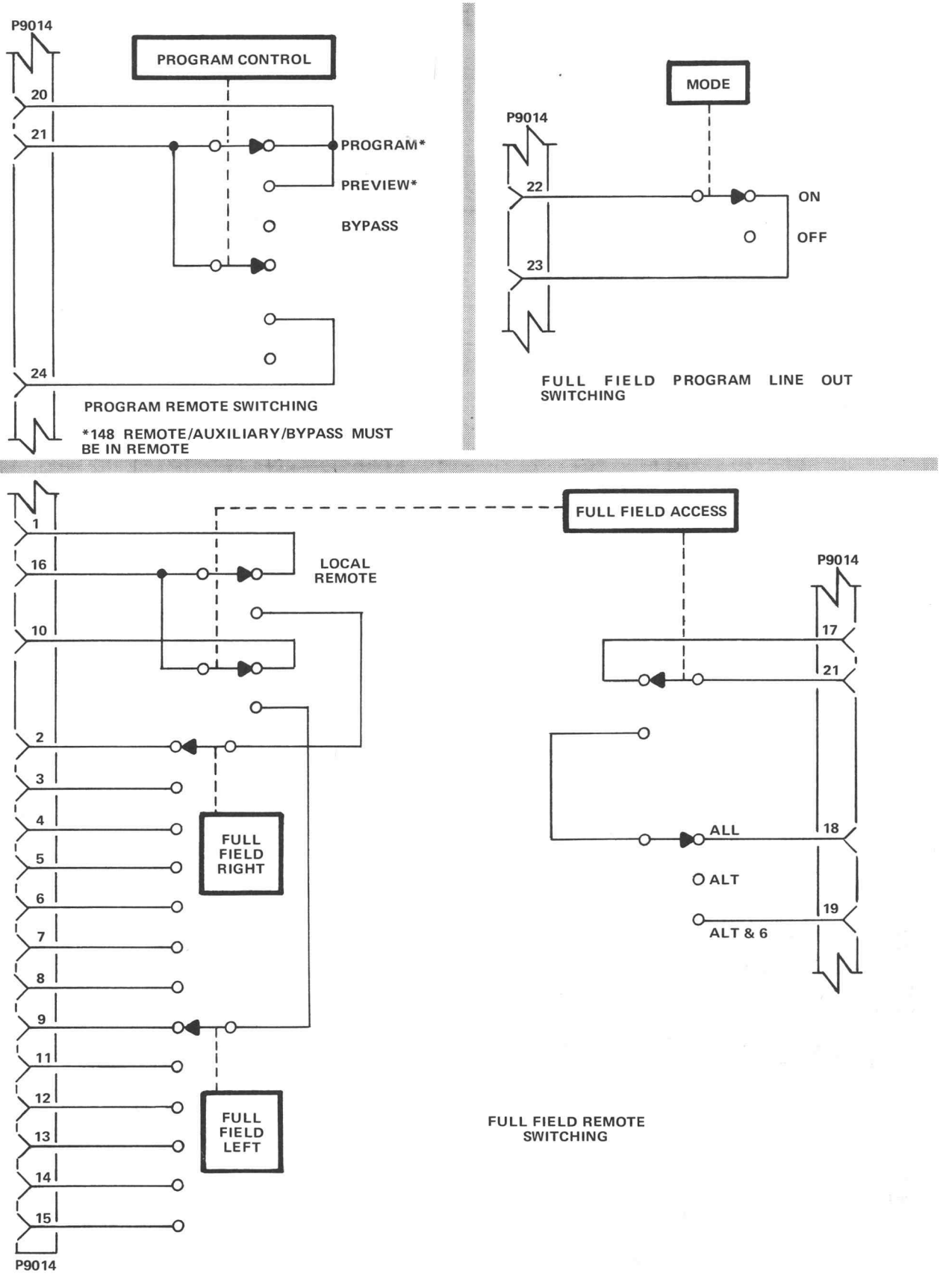


Fig. 2-3. Wiring diagrams for REMOTE operation of the 148.

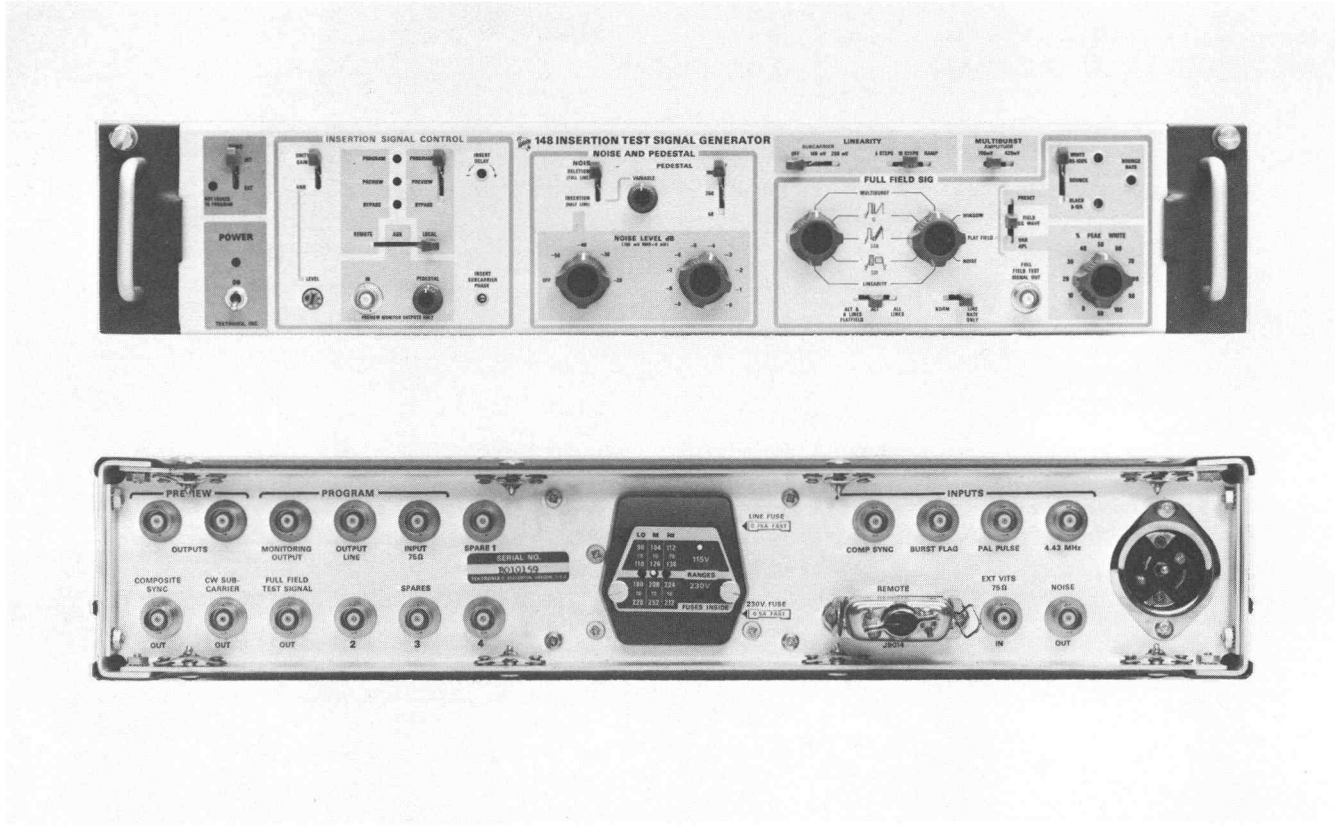


Fig. 2-4. 148 front- and rear-panel controls and connectors.

SYNC (cont)

EXT — Timing derived from signals connected to COMP SYNC, SUBCARRIER, BURST FLAG, and PAL PULSE connectors.

INSERTION SIGNAL CONTROL — Consists of three lever switches and four variable controls to select control of signal modes and to set the level of program and auxiliary pedestal signals, plus three indicator lamps to indicate status.

UNITY GAIN/ VAR — Switch selects a preset gain, normally adjusted for unity gain between program input and program output, or adjustment of gain by a front-panel LEVEL control.

LEVEL — Control normalizes the incoming signal to match the inserted signal amplitude when UNITY GAIN/ VAR switch is in the VAR position.

LOCAL/ AUXILIARY/ REMOTE — Switch determines whether control over signal insertion is local or remote.

LOCAL — Control of program or preview modes is from the 148 front panel.

AUXILIARY — In this position, a non-video signal at the AUXILIARY INPUT (such as a sweep generator or non-composite video signal) may be used. This signal then appears at the PREVIEW MONITOR outputs with interruptions for composite blanking; with sync added, it operates as a sync and blanking adder. (PROGRAM IN is connected via relay to PROGRAM OUT in this mode.)

REMOTE — In this position, operation is controllable by connection of a remote switching circuit to a rear-panel connector.

PROGRAM/ PREVIEW/ BYPASS — Switch selects one of the three modes.

PROGRAM — Test signals are inserted on the program line output according to internal selection of test signals and their time address.

PREVIEW — Test signals are inserted on the program signal as viewed on the PREVIEW MONITOR OUTPUT; used for verification prior to impressing these signals on the program output, and for full-field noise measurements.

BYPASS — Incoming signals bypass active circuits of the 148 and are delivered to the PROGRAM OUTPUT.

AUXILIARY PEDESTAL — Control provides a DC offset so that the auxiliary signal excursion may be positioned between black and white limits of the resulting composite video signal.

PROGRAM/ PREVIEW/ BYPASS Lamps — Lamps indicate the status, which may not be indicated by the PROGRAM/PREVIEW/BYPASS switch when in remote control. All lamps extinguished indicates that the Program Bypass relay is not energized.

INSERT SUB-CARRIER PHASE — Screwdriver adjustment to control phase of the colour subcarrier on internally generated signals with respect to the incoming burst signal.

INSERT DELAY — Adjustment controls time-positioning of internally generated insertion signals with respect to the incoming signal.

NOISE AND PEDESTAL — Consists of two lever switches, two rotary switches, and one variable control to select conditions of the NOISE signal.

NOISE — Refers to Insertion Signal or FF on PREVIEW MONITOR OUT.

DELETION/ INSERTION — Switch selects either DELETION (FULL LINE) which eliminates noise on the full line, or INSERTION (HALF LINE) which removes any noise present in the center half of the line. This is useful in measuring program noise levels. (FULL FIELD OUT has full line of NOISE and pedestal.)

PEDESTAL (mV) — Switch selects one of three indicated (50, 350, 700 mV) levels of pedestal on which noise measurements may be made.

VAR PEDESTAL — Control permits a variation of at least ± 50 mV in the pedestal amplitude in the INSERTION position of the NOISE switch. Permits accurate matching of pedestal level on which noise measurement is made.

NOISE LEVEL dB — Two rotary switches control the amplitude of the internally generated noise signal.

FULL FIELD SIGNAL — Consists of three rotary and seven lever switches to select the type of signal available at the FULL FIELD TEST SIGNAL OUTPUT, and to modify certain characteristics of these signals.

Signal Selector (Right) — Switch selects one of the following eight signals for FULL FIELD OUTPUT: MULTIBURST, LINE 17 SIGNAL, LINE 330 SIGNAL, LINE 331 SIGNAL, LINEARITY, NOISE, FLAT FIELD, and WINDOW.

Signal Selector (Left) — Switch selects one of the following five signals to be alternated with the signal selected by the (Right) switch: MULTIBURST, LINE 17 SIGNAL, LINE 330 SIGNAL, LINE 331 SIGNAL, and LINEARITY. Switch is inoperative unless the ALL LINES/ALT/ALT + 6 LINES lever switch is in one of the alternating positions.

ALL LINES/ ALT/ALT & 6 LINES FLAT-FIELD — Lever switch selects sequence of full-field signals.

ALL LINES — Signals selected by Right switch appears on all active lines.

ALT — Signals selected by Left and Right switches appear interleaved on alternate active lines.

ALT & 6 LINES FLAT-FIELD — Signals selected by Right and Left switches appear interleaved on alternate lines followed by 6 lines of adjustable pedestal.

FLAT FIELD — Lever switch selects amplitude and time of the Flat Field signal.

PRESET — Flat Field signal is controlled by WHITE/BOUNCE/BLACK switch.

WHITE/ BOUNCE/ BLACK

WHITE — A level adjustable between 85% and 100% of peak white by adjacent control.

BOUNCE — The active portion of the line bounces between white and black level at a repetition rate of approximately 1 to 10 seconds.

RATE — Front panel screwdriver control to set repetition rate of BOUNCE from approximately 1 to 10 seconds.

BLACK — A level adjustable between 0% and 15% of peak white by adjacent control.

VARIABLE — All active lines are the same amplitude as controlled by % PEAK WHITE switch.

% PEAK WHITE — 12-position rotary switch selects one of eleven levels of FLAT FIELD signal in 10% steps. (50% step repeated for rapid change from 0% through 100%.)

LINEARITY — Consists of two lever switches to control the LINEARITY test signal.

SUBCARRIER — Lever switch to select 140 mV, 280 mV or off (no modulation) on LINEARITY signal.

5 STEPS/ 10 STEPS/RAMP — Lever switch to select type of LINEARITY signal.

MULTIBURST AMPLITUDE — Lever switch selects one of two amplitudes of multiburst signal.

700 mV — In this position, the peak-to-peak amplitude of Multiburst will be 700 mV, centered about the 350 mV level.

420 mV — In this position the peak-to-peak amplitude of Multiburst will be 420 mV centered about the 350 mV level.

NORMAL/LINE RATE ONLY

NORMAL — Normal composite video signal with standard line and field blanking intervals.

LINE RATE ONLY — Test signals are line repetitive, i.e., no field sync or field blanking information present. This mode available in BYPASS only.

Input Connectors — All input signals (except remote plug) are via BNC type connectors.

AUX IN (1 front-panel) — 75 Ω input for non-video type signals.

EXT INSERTION SIGNAL IN (1 rear-panel) — 75 Ω input, added to composite video; output to deleter and inserter circuit. Must not have insertion signals on the lines programmed for other 148 insertion signals. (Must not have sync and burst if not disconnected when AUXILIARY is used.)

PROGRAM LINE IN (1 rear-panel)	75 Ω input for program signal.
Remote Plug (1 Rear-Panel)	24 pin connector.
COMP SYNC (1 Rear-Panel)	For external synchronization of full-field signals.
PAL PULSE (1 Rear-Panel)	For external synchronization of full-field signals.
BURST FLAG (1 Rear-Panel)	For external synchronization of full-field signals.
4.43 MHz (1 Rear-Panel)	For external synchronization of full-field signals.
Output Connectors	All output connectors are BNC type with 75 Ω impedance.
PROGRAM LINE OUT	Program output signal, with insertion signals added or not, according to program control.
PROGRAM MONITOR (1 rear-panel)	Same as PROGRAM LINE OUT, except no output present in bypass mode.
PREVIEW MONITOR (2 rear-panel)	Always has insertion signals added and may have AUXILIARY or NOISE added.
FULL FIELD TEST SIGNAL (1 front and 1 rear-panel)	Full field test signal.
CW SUB-CARRIER (1 rear-panel)	Regenerated subcarrier signal, approximately 2 volts peak-to-peak. Not present unless locked to incoming burst.
COMPOSITE SYNC (1 rear-panel)	Regenerated sync signal, approximately 4 volts peak-to-peak. Not present unless locked to incoming signals.
NOISE OUT (1 rear-panel)	Continuous random noise for calibration of internal noise source. Variable from –20 dB to –59 dB (0 dB = 700 mV RMS).

GENERAL INFORMATION

Television signals are complex waveforms. For this reason, many test units are required to check one characteristic or another of the video system.

The 148 is one such test unit, but it differs from others in that it will provide complete time-domain testing of a video system. All signals generated are controlled by a digital programmer which is Gen-Locked (normally), but may operate from its own oscillator. The 148 generates the signals shown in Fig. 1-2 of this manual.

LINEARITY—Staircase, either 5 or 10 step, or ramp is available. Subcarrier (phase locked to burst) modulates either the staircase or ramp, and may be turned off by a front-panel control. Measurement of Differential Gain and Differential Phase may be made using the LINEARITY signal.

MULTIBURST—Generated by a function generator and controlled by a digital programmer, this signal consists of a white flag (700 mV), a black reference (0 mV), and six discrete packets of burst frequencies from 0.5 to 5.8 MHz. Each burst packet may be set for an exact number of cycles, regardless of the frequency. Multiburst is generally used for quick gain vs. frequency verification.

LINE 17 SIGNAL—This signal is composed of the LINEARITY 5 Step staircase, SIN^2 PULSE AND BAR, and the Modulated Sin^2 Pulse signals. Only the horizontal timing has been changed to incorporate both signals within the time of one line.

LINE 330 SIGNAL—This signal is composed of the Integrated Sin^2 Pulse (Bar), Sin^2 Pulse, and the 5 Step Linearity signal.

Sin^2 Pulse and Bar—Sin^2 Pulse and Bar waveforms (2T and T) are generated to 9 Pole Kastelein[2] Filters. The digital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter. The

[2] **A. Kesteline, "A NEW SINE-SQUARED PULSE AND BAR SHAPING NETWORK", IEEE Transactions of Broadcasting, Volume BC-16, Number 4, Dec. 1970 (pp 84-89).**

programmer also exactly determines pulse-to-pulse spacing and bar width. However, the programmer may be reprogrammed, to produce different spacing or bar widths in 2 μs increments, should the need arise.

Application includes K Factor measurements for short time distortions.

LINE 331 SIGNAL—This signal consists of three different chrominance levels followed by a chrominance reference.

Pulse and Bar—This signal consists of the Modulated Sin² Pulse (20T) followed by the Sin² Pulse and Bar signal discussed previously.

Modulated Sin² Pulse—The 20T pulse has a 2.0 μs HAD (other pulses available), with the envelope of the pulse formed in a filter.

This signal is generally used to measure relative gain and delay error between chrominance and luminance.

WINDOW—This signal is the standard Window signal now being used within the industry, with the exception that the Modulated Sin² Pulse, and the Sin² Pulse and Bar has been added. Generally used with a picture monitor to observe streaking, etc., it is also used to check for both line and field time distortions.

FIELD SQ WAVE—This signal, similar to the WINDOW signal, has lines 65 through 270 of each field at 700 mV, thereby simulating a 60 Hz square wave, capable of passing through clamper amplifiers. It is used for accurate measuring of field time distortions.

FLAT FIELD—This composite video signal has, during the active portion of each field, a luminance level variable from 0 to 700 mV in 10% increments, or which bounces automatically between the black and white level at a repetition rate of approximately 1 to 10 seconds. It is used to test clamped amplifiers and systems in general, for APL dependent distortions.

NOISE—The calibrated noise generator provides white noise (flat) at 50, 350, or 700 mV luminance levels. This offers a unique signal to noise measuring technique, which may be performed during the vertical interval or on an out of service basis as a Full-Field signal on the PREVIEW MONITOR OUTPUTS in the PREVIEW mode of operation.

FIRST TIME OPERATION

General

The following is primarily intended to familarize operating personnel with the operation of the 148. It consists of a step-by-step procedure, which makes use of each front- and rear-panel control and connector. This procedure in most cases simulates the actual in-service operation of the 148.

The procedure makes use of a waveform monitor to observe field and line rate displays and a vectorscope to observe phase characteristics. An external video signal source is needed to provide program signal (composite video) and an external Insertion Test Signal (ITS) during the vertical interval. The following equipment is used: TEKTRONIX Type 529 MOD 188D Waveform Monitor, used to observe field and line rate displays; a TEKTRONIX 521A Vectorscope, used to observe phase characteristics; and a TEKTRONIX 141A Test Signal Generator, used to provide the external video signals. Proper operation of each unit is assumed; refer to the individual operating instructions for each.

Unless stated otherwise, all 148 front- and rear-panel controls and connectors are in upper-case letters and all controls and connectors have initial upper-case letters only.

The procedure is arranged in a sequence that depends upon previous control settings and connections, and should be performed in sequence. There are, however, certain places where all equipment is disconnected before starting a step, allowing the operator to start the procedure at this point if desired.

NOTE

The following procedure uses the equipment listed. If substitute equipment is used, control settings and connections may need to be altered.

Procedure

1. Remove the REMOTE plug, P9014. (See INSTALLATION; Local-Remote Connector, in this section for details.)

2. Set the 148 controls as follows: INSERTION SIGNAL CONTROL—UNITY GAIN, PROGRAM, and LOCAL; SYNC—INT; POWER—OFF; NOISE AND PEDESTAL—DELETION, 700 mV, OFF, and 0 dB; LINEARITY—280 mV and 5 STEPS; MULTIBURST AMPLITUDE—700 mV; FULL FIELD SIG—LINEARITY (Left and Right

Mode), ALL LINES, NORM, BOUNCE, PRESET, and 100% PEAK WHITE.

3. Check for correct positioning of the 148 Range and Voltage Selectors. (See INSTALLATION; Operating Voltage, in this section for details.)

4. Set the POWER switch ON. Note that the green power-on indicator lamp is lit, indicating power is being supplied to the instrument. Note that the red NOT LOCKED TO PROGRAM lamp is lit, indicating lack of Gen-Lock. Note that the red BYPASS lamp is lit, indicating status.

NOTE

Without Gen-Lock, the 148 will not delete or insert ITS.

5. Display the 148 front-panel FULL FIELD TEST SIGNAL OUT on the Waveform Monitor A Input; terminate the loop-through A Input into 75 Ω.

6. Observing the waveform monitor at a 2 Field Display rate, note that composite sync and burst are the only signals being generated by the 148.

7. Connect the REMOTE plug, P9014.

8. Observing the waveform monitor display, note that full-field signals are now being generated by the 148. Observe the display at a 2 Line Display rate. The 5 Step LINEARITY test signal, similar to that shown in Fig. 1-2 of this manual, should be displayed.

9. Change the 148 LINEARITY switches. The display will be either the 5 Step, 10 Step, or Ramp LINEARITY test signal with or without modulation as determined by the setting of the SUBCARRIER switch. Set the LINEARITY switches to display the 5 Step (with modulation) LINEARITY test signal.

10. Set the FULL FIELD SIG (Right) Mode switch to FLAT FIELD. Observe the waveform monitor display for several seconds. Notice that the display consists of sync, burst, and a square-wave. The square wave should automatically bounce between white and black. Using a small-blade screwdriver, rotate the front-panel BOUNCE RATE control. Note that the time required to bounce between white and black can be varied from approximately 1 second to greater than 10 seconds. Set the BOUNCE RATE control to any desired position.

Set the WHITE/BOUNCE/BLACK switch to WHITE. The square wave should be 85% to 100% of white (700 mV) as set by the adjacent control. Set the switch to BLACK. The square wave should be 0 to 15% of peak white as set by the adjacent control. Return the switch to BOUNCE.

11. Set the PRESET/FIELD SQ WAVE/VAR APL switch to FIELD SQ WAVE. Note that the square wave is at 700 mV and is independent of the WHITE/BOUNCE/BLACK switch setting. Observe the waveform monitor at a 2 Field Display rate. Notice that the square wave occupies only lines 65 through 270 of each field.

12. Set the PRESET/FIELD SQ WAVE/VAR APL switch to VAR APL. Note that all active lines of each field are at 700 mV. Rotate the % PEAK WHITE switch through each setting. Note that the square wave decreases in amplitude. This control allows the operator to select any APL level desired in 10% increments between 0% and 100%. Notice the (50) position of this switch between 0 and 100. As a convenience to the operator, this position allows standard 0-50-100 APL measurements to be made without completely rotating the switch 360°. Set the waveform monitor for a 2 Line Display rate and the % PEAK WHITE switch to 50.

13. Set the 148 FULL FIELD SIG (Right) Mode switch to WINDOW. This signal will be similar to that shown in Fig. 1-2 of this manual. It consists of the 2T Pulse, Modulated 20T Pulse and a T Bar. (See Operating Changes; this section, for exceptions.) Observe the waveform monitor at a 2 Field Display rate. Notice that the 2T Pulse and Modulated 20T Pulse occur each active line of both fields, but that the T Bar occurs only part of each field. The T Bar portion of this signal occupies active lines 65 through 270 of each field. Set the waveform monitor for a 2 Line Display rate.

14. Set the 148 FULL FIELD SIG (Right) Mode switch to MULTIBURST. This signal should be similar to that shown in Fig. 1-2 of this manual. The signal occupies all active lines of both fields. Set the MULTIBURST AMPLITUDE switch to 420 mV. Notice the reduced peak-to-peak amplitude of each burst packet, and the reduced amplitude of the white and black reference levels. Return the MULTIBURST AMPLITUDE switch to 700 mV.

15. Set the 148 FULL FIELD SIG (Right) Mode switch to LINE 17 SIGNAL. This signal should be similar to that shown in Fig. 1-2 of this manual. It consists of the

Modulated 20T Pulse, 2T pulse, and the unmodulated 5 Step Staircase. These signals are similar to that described for the Window and Linearity, except that the horizontal timing has been changed to incorporate them within the time of one line. Change the LINEARITY switches. Notice that the Staircase portion of the signal cannot be changed.

16. Set the 148 FULL FIELD SIG (Right) Mode switch to LINE 330 SIGNAL. The signal should be similar to that shown in Fig. 1-2 of this manual. The LINE 330 SIGNAL is similar to the LINE 17 SIGNAL, except that the Modulated 20T Pulse has been eliminated and the 5 Step Staircase modulation has been added. Change the LINEARITY switches. Notice that the Staircase portion of the signal cannot be changed.

17. Set the 148 FULL FIELD SIG (Right) Mode switch to LINE 331 SIGNAL. The signal should be similar to that shown in Fig. 1-2 of this manual. It consists of a three-(3)-level chrominance bar followed by a reference chrominance bar. (See Operating Changes; this section, for exception.)

18. Set the 148 FULL FIELD SIG (Right) Mode switch to NOISE. This signal is controlled by the NOISE AND PEDESTAL controls. Set the PEDESTAL (mV) switch to 350 mV, then 50 mV, and back to 700 mV. Note that the pedestal amplitude corresponds to the setting of this switch. (In the DELETION mode, this is the only switch affecting the signal.) Set the NOISE switch to INSERTION. The display should be similar to that obtained in the DELETION mode. Rotate the VARIABLE control. Note that the pedestal level can be changed above and below the level determined by the setting of the PEDESTAL switch. Set the NOISE LEVEL 10 dB switch to −20 dB. Notice that noise has been added to the pedestal. Rotate the 1 dB switch. There should be a decrease in the noise level. These two dB switches provide noise attenuation from −20 dB to −59 dB in 1 dB steps. (700 mV RMS = 0 dB.) Set the dB switches for −20 dB. Rotate the VARIABLE control to center the display noise about the 700 mV pedestal level.

NOTE

In steps 8 through 18, each FULL FIELD TEST SIGNAL has been demonstrated. Also, these signals were demonstrated in a free-running mode. In the free-running mode, subcarrier free-runs at approximately 4.43 MHz; line and field sync are mutually coherent, but not with subcarrier.

19. Display the 148 rear-panel NOISE OUT on the Waveform Monitor A Input; terminate the A Input loop-through into 75 Ω. Change the NOISE AND PEDESTAL switches. Note that the noise amplitude is controlled only by the NOISE LEVEL dB switches. The signal at this output is continuous (e.g., no line or field sync).

NOTE

An in-line low pass filter must be used with this output.

20. Display the 148 rear-panel COMP SYNC OUTPUT on the waveform monitor. There should be no composite sync, as the 148 must be Gen-Locked to produce an output at this connector.

21. Connect the 148 rear-panel CW SUBCARRIER OUTPUT to the Vectorscope CH A connector; terminate the CH A loop-through into 75 Ω There should be no subcarrier, as the 148 must be Gen-Locked to produce an output at this connector.

NOTE

In the steps to follow the procedure will, where possible, simulate the actual in-service operation of the 148.

22. Using 75 Ω coaxial cables and 75 Ω terminations make the following connections.

a. 148 PROGRAM OUTPUT LINE to Waveform Monitor A Input, A Input loop-through to the Vectorscope CH A Input, terminate CH A loop-through into 75 Ω.

b. 148 PREVIEW OUTPUT to Waveform Monitor B Input, B Input loop-through to the Vectorscope CH B input; terminate CH B loop-through into 75 Ω.

c. External Video Source subcarrier to the Vectorscope Ext CW ϕ Ref Input, terminate Ext CW ϕ Ref loop-through into 75 Ω.

d. External Video Source composite sync to the Waveform Monitor Ext Neg Sync Input, Ext Neg Sync Input loop-through to Vectorscope Ext Sync Input, terminate Ext Sync Input loop-through into 75 Ω.

e. External Video Source composite video to the 148 PROGRAM INPUT.

23. Set the 148 controls and switches as given in step 2 of this procedure, except set the POWER switch ON and

the INSERTION SIGNAL CONTROL to PREVIEW. Set the Vectorscope to view the CH A Input (PROGRAM OUTPUT LINE) in a vector mode using external sync and ϕ reference. Set the Waveform Monitor to view the A Input (PROGRAM OUTPUT LINE) at a 2 Line Display rate using external sync. Set the External Video Source for full-field colour bars with an Insertion Test Signal (this procedure makes use of a modulated staircase ITS) on lines 20/333, both fields.

24. Notice that the 148 front-panel NOT LOCKED TO PROGRAM lamp is extinguished. This indicates the 148 has been Gen-Locked with the external video and is capable of deletion and insertion. (If this lamp is lit, check that the SYNC switch is set to INT.)

25. Notice that the 148 PREVIEW lamp is lit to indicate status. In this mode, the external video to the PROGRAM INPUT is being passed to the PROGRAM OUTPUT without interruption, as indicated by the Waveform Monitor and Vectorscope displays.

26. Observe the Waveform Monitor B Input (PREVIEW OUTPUT) at a 2 Field Display rate (use maximum magnification if desired). Notice that the internally generated ITS have been added to the signal. The signal appearing at the PREVIEW OUTPUT in the PREVIEW mode allows the operator to observe the actual signal after insertion without actually going to an "on-the-air" mode of operation.

27. Using Table 2-2, check that all insertion test signals, as factory programmed, are being inserted on the correct line and field.

TABLE 2-2

148 Factory Connected ITS Programming

Line	Fields	Signal
17	1,3	LINE 17 SIGNAL
18	1,3	MULTIBURST
19	1,3	NOISE[3]
330	2,4	LINE 330 SIGNAL
331	2,4	LINE 331 SIGNAL

[3]NOISE will be displayed in the center half of line 19 only, and will be explained later in the procedure.

28. Set the 148 INSERTION SIGNAL CONTROL to PROGRAM. Observe the Waveform Monitor A Input (PROGRAM OUTPUT LINE). Notice that the internally generated ITS have been applied to the "on-the-air" signal. Note also that the 148 front-panel PROGRAM lamp is lit to indicate status.

29. Set the External Video Source to provide an insertion test signal on one of the lines that has been programmed for insertion by the 148. Observing the Waveform Monitor display, set the 148 POWER switch OFF. Note that the external insertion test signal is being displayed. This indicates that external video has bypassed the 148, and demonstrates the fail-safe characteristic of the 148 should loss of power, sync etc., occur during "on-the-air" (PROGRAM) situation. Return the POWER switch to ON.

30. Observing the Waveform Monitor display, interrupt the external composite video to the 148 PROGRAM INPUT. Notice that the display now consists of the Full-Field signal (as set by the FULL FIELD SIG switch) generated by the 148. In the event of loss of incoming video, the 148 provides internally generated Full-Field test signals at the PROGRAM OUTPUT. (For exception, see Operating Changes, this section for details.) Return the external composite video signal to the 148 PROGRAM INPUT.

31. Set the Waveform Monitor to view line 19, fields 1 and 3. Set the External Video Source to provide the Insertion Test Signal on line 19, fields 1 and 3. Set the 148 NOISE switch to INSERTION. Note that the center half of the external ITS has been deleted and that the internally generated NOISE signal has been inserted. This allows noise measurements to be made during the vertical interval during "on-the-air" conditions. Change the 148 NOISE AND PEDESTAL switches. Note that their effect is the same as that for the Full-Field signals.

32. Set the Waveform Monitor to view the B Input (PREVIEW OUTPUT) at a 2 Line Display rate. Set the 148 INSERTION SIGNAL CONTROL to PREVIEW and the FULL FIELD SIG (Right) Mode switch to NOISE. Notice that each active line contains the external video signal with interruptions for noise.

NOTE

The signal appearing at the PREVIEW MONITOR OUTPUT is available only in the PREVIEW Mode with NOISE selected as the Full-Field signal.

33. Set the External Video Source to provide an insertion test signal on one of the lines programmed for internal ITS. Observe the Waveform Monitor B Input (PREVIEW OUTPUT) at a 2 Field Display rate. Notice that the external ITS has been deleted. Next, connect an external insertion test signal to the 148 rear-panel EXT ITS INPUT. Do not terminate the line. (If using a TEKTRONIX Type 141A Test Signal Generator as the External Video Source, connect the unused Comp Video connector to the

148 EXT ITS IN connector.) Notice that the external ITS (via the EXT ITS INPUT) has been added to the internally programmed ITS, causing the display to be distorted. This demonstrates why **external ITS to the EXT ITS INPUT must not be programmed on the same line and field as internal ITS.**

34. Observing the Waveform Monitor A Input at a 2 Field Display rate and the Vectorscope CH A Input vectors (both are PROGRAM OUTPUT), set the 148 INSERTION SIGNAL control to PROGRAM, VAR, and rotate the LEVEL control. The amplitude of the external composite video can now be varied with this control. Observe the vertical interval on the Waveform Monitor with maximum magnification. Rotation of the LEVEL control should not affect the inserted test signals. Turn off the Waveform Monitor magnification and adjust the LEVEL control for an overall signal amplitude of 1 volt peak-to-peak. The LEVEL control allows the operator to match incoming program composite video to the internally generated signals. Set the INSERTION SIGNAL CONTROL to UNITY GAIN.

35. Observing the Vectorscope display, rotate the INSERT SUBCARRIER PHASE control. There should be a vector representing the internally generated subcarrier. Superimpose this vector upon the vector representing external subcarrier. The INSERT SUBCARRIER PHASE control enables the operator to match the phase of the internally generated subcarrier to the phase of the external subcarrier.

36. Set the 148 INSERTION SIGNAL CONTROL to AUX and view the Waveform Monitor B Input (PREVIEW OUTPUT) at a 2 Line Display rate. Sync and burst should be double amplitude. Disconnect the 75 Ω cable from the 148 rear-panel EXT ITS INPUT. Sync and burst should be normal amplitude. This demonstrates why **in AUXILIARY mode and with an external ITS input, there must be no SYNC or BURST added with the external ITS.**

37. Observing the Waveform Monitor display, rotate the INSERTION SIGNAL CONTROL PEDESTAL control. Notice that an apparent square wave can be adjusted from below blanking to greater than 700 mV. Display the PROGRAM MONITORING OUTPUT in place of the PREVIEW OUTPUT on the Waveform Monitor B Input. Notice that there is no output from this connector. Display the Waveform Monitor A Input (PROGRAM OUTPUT). Notice that external composite video is being displayed. The auxiliary signal will only be available at the PREVIEW OUTPUT. In addition, this is the only mode of operation where the PROGRAM OUTPUT and PROGRAM MONITORING OUTPUT do not have the same signals.

38. Display the PREVIEW OUTPUT in place of the PROGRAM MONITORING OUTPUT on the Waveform Monitor B Input. Apply any signal to the 148 front-panel AUXILIARY INPUT connector. The same signal that is used for external ITS is used for this procedure. Notice that the external signal applied to the AUXILIARY INPUT has been added on the auxiliary pedestal level. This input can be driven by any signal desired for specific application such as sweep generator.

39. Set the 148 INSERTION SIGNAL CONTROL LOCAL/AUX/REMOTE switch to REMOTE. Note that the PREVIEW lamp is lit to indicate status (unless PROGRAM/PREVIEW/BYPASS switch is in BYPASS, then BYPASS lamp is lit at all times). Observe the Waveform Monitor A Input at first a 2 Line Display rate, then a 2 Field Display rate. The external composite video should be appearing at this output without interruption.

40. Set the 148 controls and switches as given in step 2, but set the POWER switch to ON. Display the 148 FULL FIELD TEST SIGNAL OUTPUT in place of the PREVIEW OUTPUT on the Waveform Monitor B Input. Set the Waveform Monitor for a 2 Field Display rate with maximum magnification. This should be the LINEARITY test signal. Next, set the FULL FIELD SIG switch to ALT. Notice that there is no apparent change of the display. Now, rotate the FULL FIELD SIG (Left) Mode switch through its five positions. Notice that the display is now alternating each line between the signal set by the (Left) and that set by the (Right) Mode switch.

41. Observing the Waveform Monitor display, set the FULL FIELD SIG switch to ALT & 6 LINES FLAT FIELD. The display should now consist of one active line as selected by the (Right) Mode switch, the next line as selected by the (Left) Mode switch, followed by 6 lines of FLAT FIELD as controlled by the BOUNCE/WHITE/BLACK switch or by the % PEAK WHITE switch, all of which is dependent upon the setting of the PRESET/FIELD SQ WAVE/VAR APL switch.

42. Turn off the Waveform Monitor Magnification. The display should be a 2 Field display of the FULL FIELD TEST SIGNAL OUTPUT. Set the 148 FULL FIELD SIG NORM/LINE RATE ONLY switch to LINE RATE ONLY. Notice that there is no apparent change. Now, set the 148 INSERTION SIGNAL CONTROL switch to BYPASS. The display should consist of line rate synchronization only. (E.g., there is no field sync ect.) Set the NORM/LINE RATE ONLY switch to NORM.

43. Observing the waveform monitor display at either a 2 Line or 2 Field Display rate, set the 148 SYNC switch to EXT. The display should be free-running and the red NOT

LOCKED TO PROGRAM lamp should be lit. From the External Signal Source, connect, COMP SYNC, SUB-CARRIER, BURST FLAG, and PAL PULSE to the respective input connectors on the 148 rear-panel. Note that the red NOT LOCKED TO PROGRAM lamp is extinguished and that the display is locked.

This completes the first-time operating procedure.

OPERATING CHANGES

General Information

The 148 is factory connected to generate test signals that are most frequently used by the television industry. However, many internal changes can be made to alter these signals to meet certain applications. For example, the LINE 17 SIGNAL and LINE 330 SIGNAL contain the five Step Staircase as a portion of the total signal. This may be internally changed to provide the ramp signal (in place of the staircase) on these signals.

The following provides the information necessary to change or modify the 148 where possible.

NOTE

Some of the changes or modifications that follow require internal adjustment and programming to comply with industry standards. We recommend that only qualified personnel, thoroughly familiar with calibration procedures and the video signals, make these changes.

Full Field Burst

As shipped from the factory, loss of burst on the PROGRAM IN signal (or loss of PAL pulse, burst flag, or subcarrier in the EXT SYNC mode) will cause the 148 burst and subcarrier components of the FULL FIELD TEST SIGNALS to free run.

If desired, the free running burst may be removed from the FULL FIELD TEST SIGNALS by changing the connector on pins 1 and 2 of P482 to pins 2 and 3 (P482 located on the Subcarrier and Sync Out circuit board, see Fig. 2-5).

Loss of Program (PROGRAM mode only)

As shipped from the factory, the FULL FIELD TEST SIGNALS are routed to the PROGRAM OUTPUT LINE in the event that the PROGRAM INPUT signal is interrupted. If desired, the 148 may be connected so that the PROGRAM OUTPUT LINE is interrupted if the PROGRAM INPUT signal is interrupted. This is accomplished by disconnecting pins 22 and 23 of the remote plug, P9014. (P9014 is located on the rear-panel, see Fig. 2-1.)

Line 331 Chrominance Bar

As shipped from the factory, LINE 331 SIGNAL consists of a three-level chrominance bar and a reference chrominance bar. If desired, the three-level chrominance portion of this test signal may be changed to produce a one level, 700 mV chrominance bar, by changing the connector on pins 1 and 2 of P8080 and P8180 to pins 2 and 3

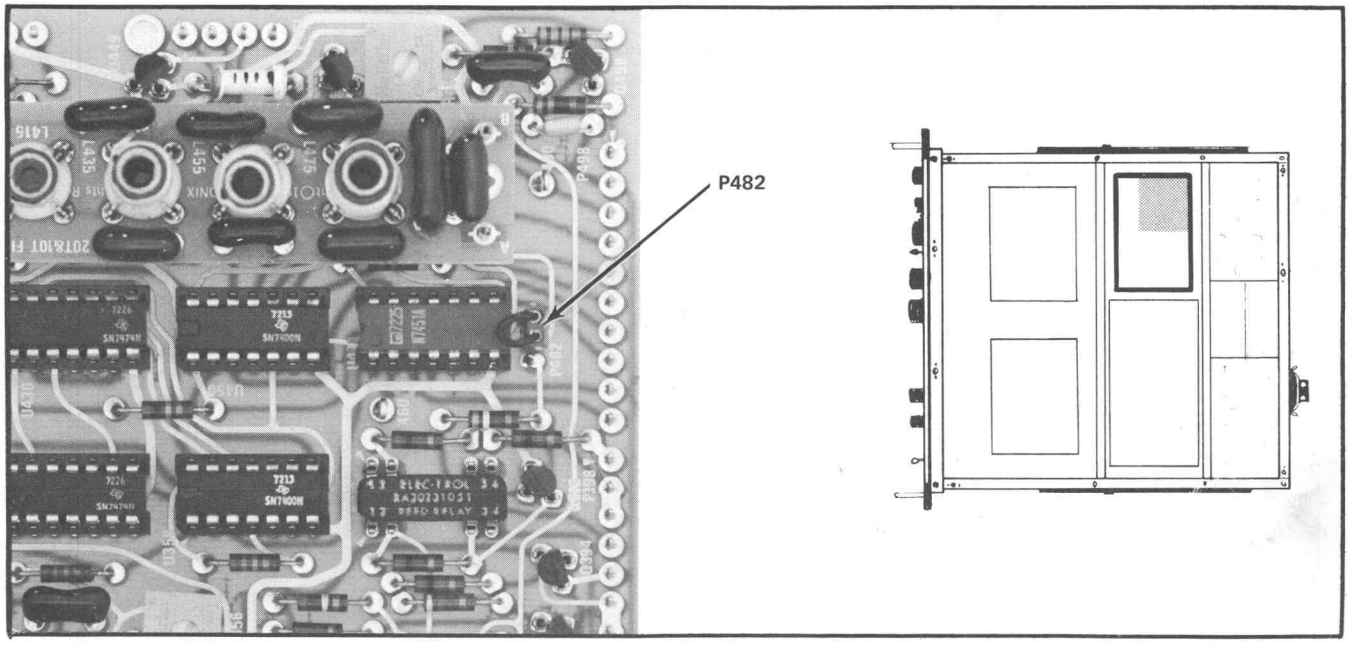


Fig. 2-5. Subcarrier and Sync circuit board showing location of P482; Full Field Burst.

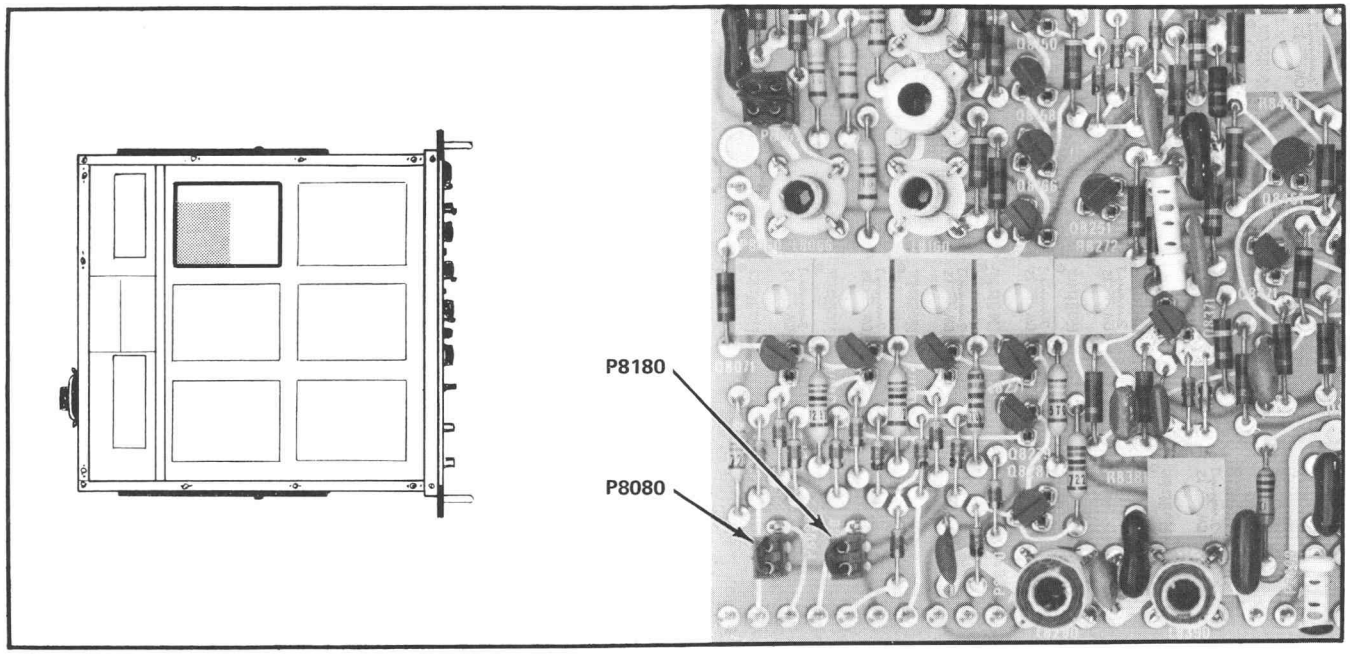


Fig. 2-6. Modulator circuit board showing locations of P8080 and P8180; Line 331 Chrominance Bar.

(P8080 and P8180 are located on the Modulator circuit board, see Fig. 2-6).

Program Source Identification

For identifying originating sources, provisions for up to 25 pulses in any combination of Characteristic Instants between 6 and 32 (see Horizontal Programming, this section for details), may be programmed onto lines 16 or 329 on fields 1 and 3, fields 2 and 4, or all fields.

No coding is shipped from the factory. To use, determine the coding desired and connect wires between the Characteristic Instant pins (located on the Horiz Timing circuit board, see Fig. 2-13) and the input pins on the Identification Code circuit board, see Fig. 2-7. For field selection, see Insertion Test Signal Line and Field Selection in this section for details.

Insertion Test Signal Line and Field Selection

Insertion Test Signals (ITS) may be selected to appear on lines 11/324 through 22/335 of fields 1 and 3, fields 2

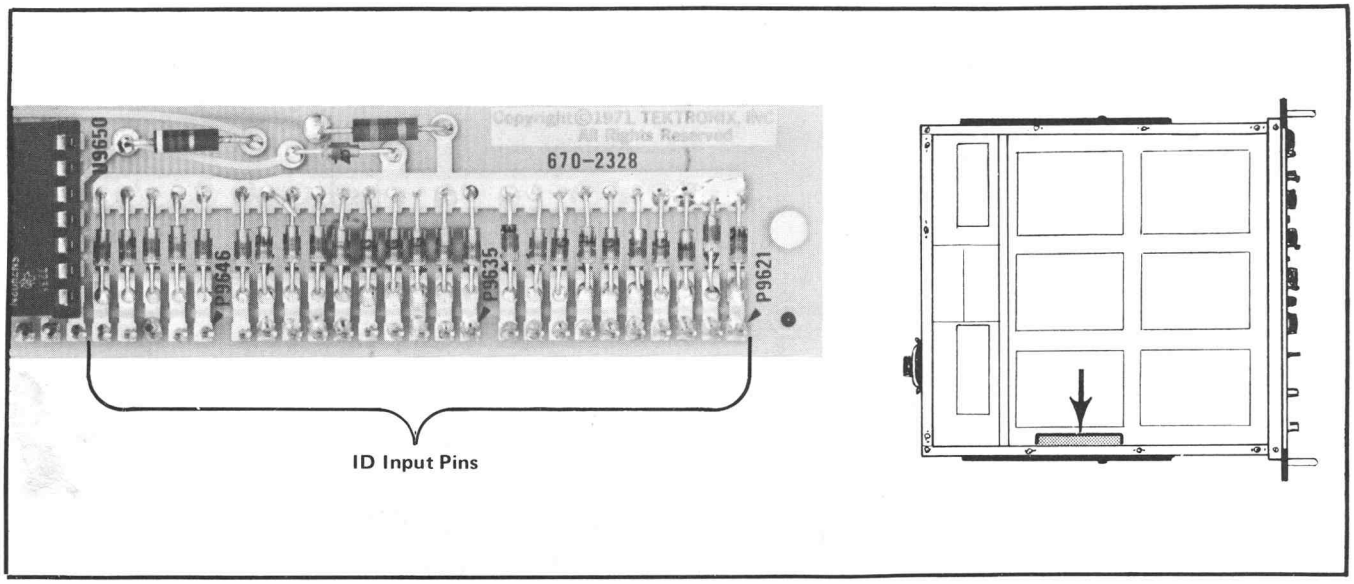


Fig. 2-7. Identification Code circuit board showing locations of input pins; Program Source Identification.

and 4, or all fields. Line and Field selection is accomplished by selecting various internal quick-change pin connectors on the ITS and FF circuit board, see Fig. 2-8. An access door is provided so that ITS selection can be made without removing the top cover from the instrument.

Referring to the ITS and FF circuit board, notice that a rectangular matrix is used to select the Line and Field for each ITS. Two jumper plugs must be used to select the ITS; one for field selection, the other for line selection. (Exception: Identification Coding has only field selection; if used, coding will appear on line 16 or line 329 only.)

To prevent or disable a particular ITS, except Identification Coding, move the line jumper plug to the OFF position.

Each jumper plug has been assigned a particular colour which are brown, red, orange, yellow, green, blue, and black. This coding simplifies identifying the various ITS, and any same-colour jumper plug on the ITS and FF circuit board will affect only that particular signal.

The following information details each ITS available:

LINE 330 SIGNAL, LINE 17 SIGNAL, MULTIBURST, LINE 331 SIGNAL, NOISE.

Operating personnel may select any line from 11/324 through 22/335 of fields 1 and 3, fields 2 and 4, or all fields.

Ext—Linearity—P & B

Operating personnel may select any line from 11/324 through 22/335 of fields 1 and 3, fields 2 and 4, or all fields as follows:

LINEARITY—Pins 2 and 3 of P4060 must be connected.

P & B (WINDOW)—Pins 1 and 2 of P4060 must be connected.

EXTERNAL—Pins 2 and 4 of P4060 must be connected. External ITS applied to rear-panel EXT ITS connector. External ITS only on above programmed line and fields.

Erase—Ext

Operators may select lines in any sequence between 11/324 and 22/335 for deletion of any incoming ITS on the PROGRAM LINE of fields 1 and 3, fields 2 and 4, or all fields. Any line selected for incoming ITS deletion may add a signal by insertion through the EXT ITS input.

NOTE

Any signal applied to EXT ITS IN will add to internally programmed signals if inserted on same line(s).

If sync and burst are present at EXT ITS IN they will add to PREVIEW outputs in AUX and BYPASS. They will

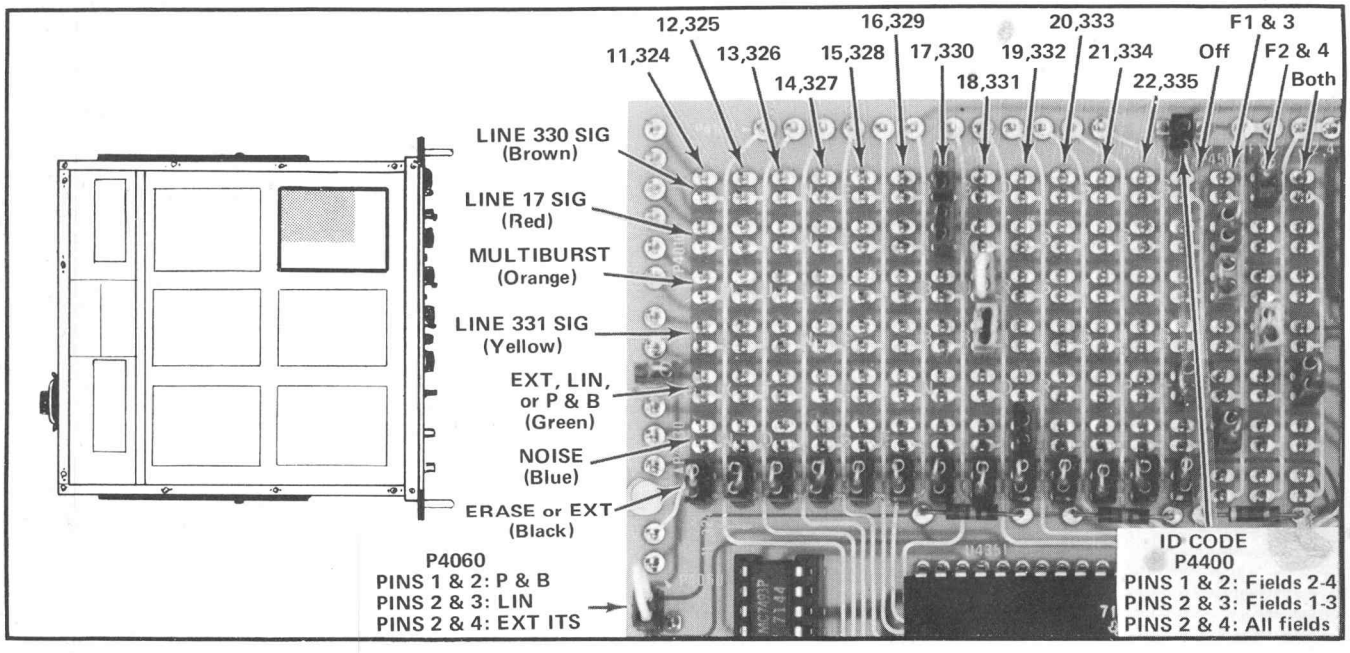


Fig. 2-8. ITS and FF circuit board showing locations of ITS Line and FIELD selector plugs; Insertion Test Signal Line and Field Selection.

also add to FULL FIELD SIGNAL OUT, and PROGRAM LINE OUT (if there is loss of PROGRAM IN).

2T/T Sine-Squared Pulse

As shipped from the factory, the 148 generates the 2T Pulse. To display the T Pulse in place of the 2T Pulse, (1) change the connector on pins 1 and 2 of P7131 to pins 2 and 3, and (2) change the connector on pins 5 and 6 of P7321 to pins 4 and 5. (P7131 and P7321 are located on Output circuit board, see Fig. 2-9.)

T/2T Bar (Integrated Sine-Squared Pulse)

As shipped from the factory, the 148 generates the 2T Bar. To display the T Bar in place of the 2T Bar, change the connector on pins 1 and 2 of P7321 to pins 2 and 3.

Window (P & B) Modulated Pulse Phase Change/ Advance 180°

The following changes are grouped because of interaction:

Phase Change

As factory connected, the phase of the Modulated Sine-Squared Pulse (20T) is set to 60°. If desired, the phase may be changed from the 60° position to allow for source coding. Interchange the wires in P8200-1 and P8100-4 (see diagram 8), and adjust R8024 and R8028 to phase the modulation as desired. See Fig. 2-10 for location of R8024, R8028, P8100, and P8200.

Advance 180°

If needed, the phase can be changed 180° from that set by adjustment of R8024 and R8028 by rotating the connector on P8055 90°. This provides a 360° control range of modulated sine-squared pulse phase.

Line 17 and Line 330 Test Signal with Ramp

As shipped from the factory, LINE 17 SIGNAL and LINE 330 SIGNAL each contain the 5 Step Staircase as a portion of the complete signal. To replace the steps portion with ramp, rotate P3760 180°, and change the connector on pins 1 and 2 of P3620 to pins 2 and 3. (P3620 and P3760 are located on the APL, Staircase, Noise circuit board, see Fig. 2-11.)

NOTE

Requires horizontal programming and internal adjustment.

Adjustment Procedure

a. Set the 148 LINEARITY SUBCARRIER switch to OFF, and view either the LINE 17 SIGNAL or the LINE 330 SIGNAL on a waveform monitor or display device.

b. Using Fig. 2-13 and Table 2-3 as guides, program the RAMP as follows:

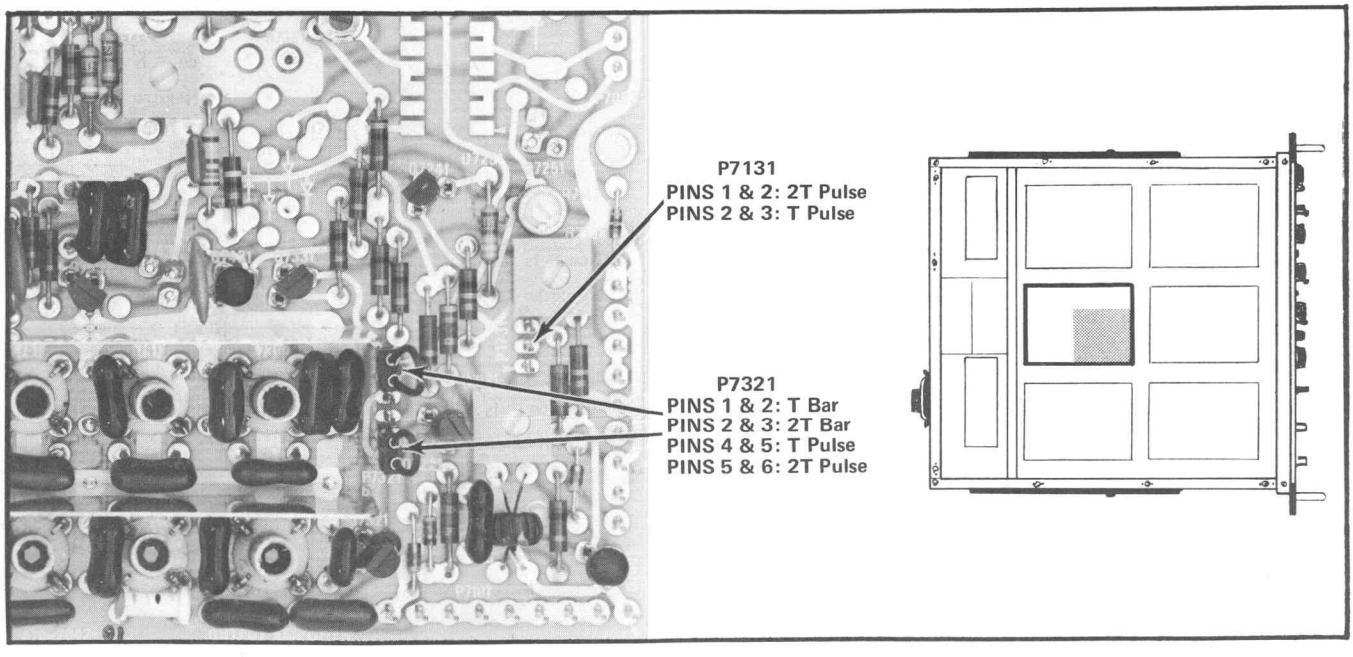


Fig. 2-9. Output circuit board showing locations of P7131 and P7321; 2T/T sine-squared Pulse and T/2T Bar (Integrated Sine-Squared Pulse).

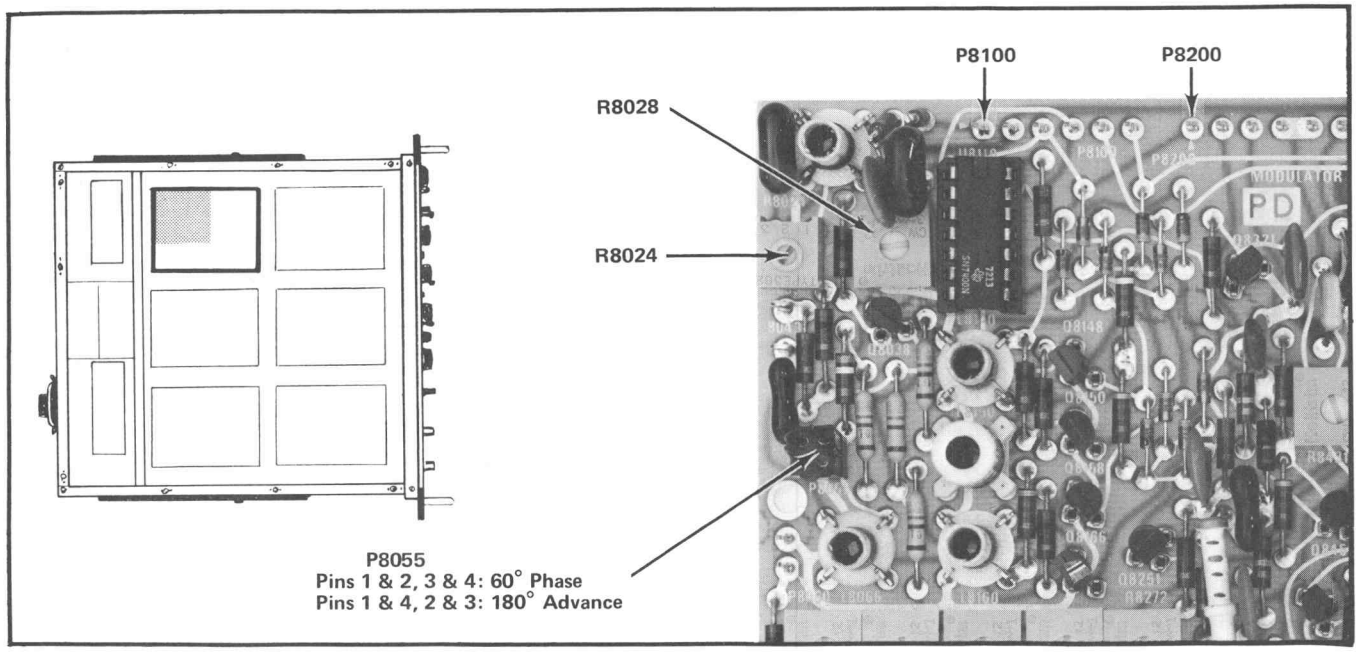


Fig. 2-10. Modulator circuit board showing locations of R8024, R8028, and P8055; Window (P & B) Modulated Pulse Phase Change/Advance 180°.

SET, Instant 19. (As shipped from the factory, this will be the white wire with black stripe and brown connector on Instant 9. Move this wire to Instant 19.)

c. Adjust the Ramp Amplitude control, R3616, for a ramp amplitude of 700 mV as measured between the blanking level and ramp peak. (R3616 located on the APL, Staircase, Noise circuit board, see Fig. 2-11.)

Gen-Lock, Burst or CW (Residual Subcarrier)

As shipped from the factory, the 148 will Gen-Lock to signals containing composite sync with subcarrier present during the burst time interval. In this mode, sound-in-syncs will not affect lock.

If desired, the 148 may be programmed to lock to burst in the presence of residual subcarrier, without phase shift

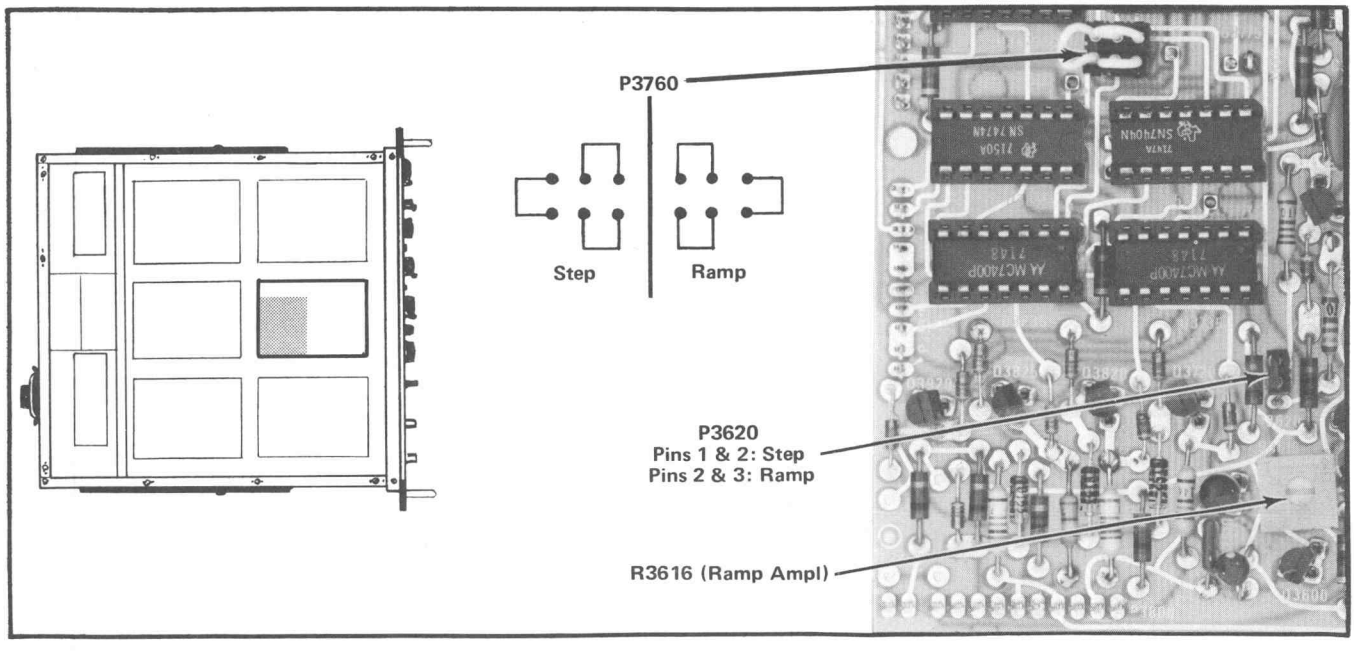


Fig. 2-11. APL, Staircase & Noise circuit board showing locations of P3620, P3760, and R3616; Line 17 and Line 330 Test Signal with Ramp.

due to residual subcarrier. **This mode should not be used in the presence of sound-in-syncs since the 148 system uses residual subcarrier at sync time as a reference.** Change the connector on pins 2 and 3 of P5150 to pins 1 and 2. (P5150 is located on Gen-Lock circuit board, see Fig. 2-12.)

Horizontal Programming

The 148 generated test signals may be internally reprogrammed, using quick-change connectors, to provide test signals which are timed according to specific user applications. Fig. 1-2 of this manual shows the signals generated, along with all timing information.

Using the LINEARITY RAMP test signal as an example, notice that the horizontal axis has been plotted from 0 to 32, with 5, 9, 28, 29, and 31 listed along the axis. Each of these listed times correspond to a particular portion of the complete signal which can be reprogrammed as desired. In other words, the subcarrier modulation on this signal may be reprogrammed to start at some time other than 5, or eliminated.

Characteristic Instant

All signal programming is controlled by selection of various gate signals derived by the Horizontal Counter. These gate signals are brought to circuit board square pins for easy access. (See Horiz Timing circuit board, Fig. 2-13.) There are three groups of pin connectors: Instant, +, and 1/2 Instant. The first group, Instant, is arranged to provide 32 columns of pin connectors. These columns are numbered, left to right, 3, 4, ... 32, 1, and 2. Each number is a Characteristic Instant and is exactly equal to 64.0 μs ÷ 32, (2 μs). The Characteristic Instant, therefore, represents the time axis of Fig. 1-2.

The second group of pins, + (P2730), contains three pins. These pins are used to connect unused programming wires when desired.

The third group of pins, 1/2 Instant (P2950), contains two pins which are internally connected to provide a 1/2 Characteristic Instant (1 μs) timing change.

Table 2-3 lists the programming as factory connected, and for obvious reasons, all wires and connectors used to program the 148 have been colour coded. Use of Table 2-3 will be covered in the following example.

Example: This example uses the WINDOW signal and will involve all three groups of Instants. It is assumed that the 20T Modulated Pulse, 2T Pulse, and T Bar have been completely disabled (e.g., all programming wires associated with this signal are disconnected) and that it will be programmed to provide the same timing as that shown in Fig. 1-2.

Proceed as Follows:

a. Referring to Table 2-3, scan the Signal, Affected Portion, and Function columns for all possible connections

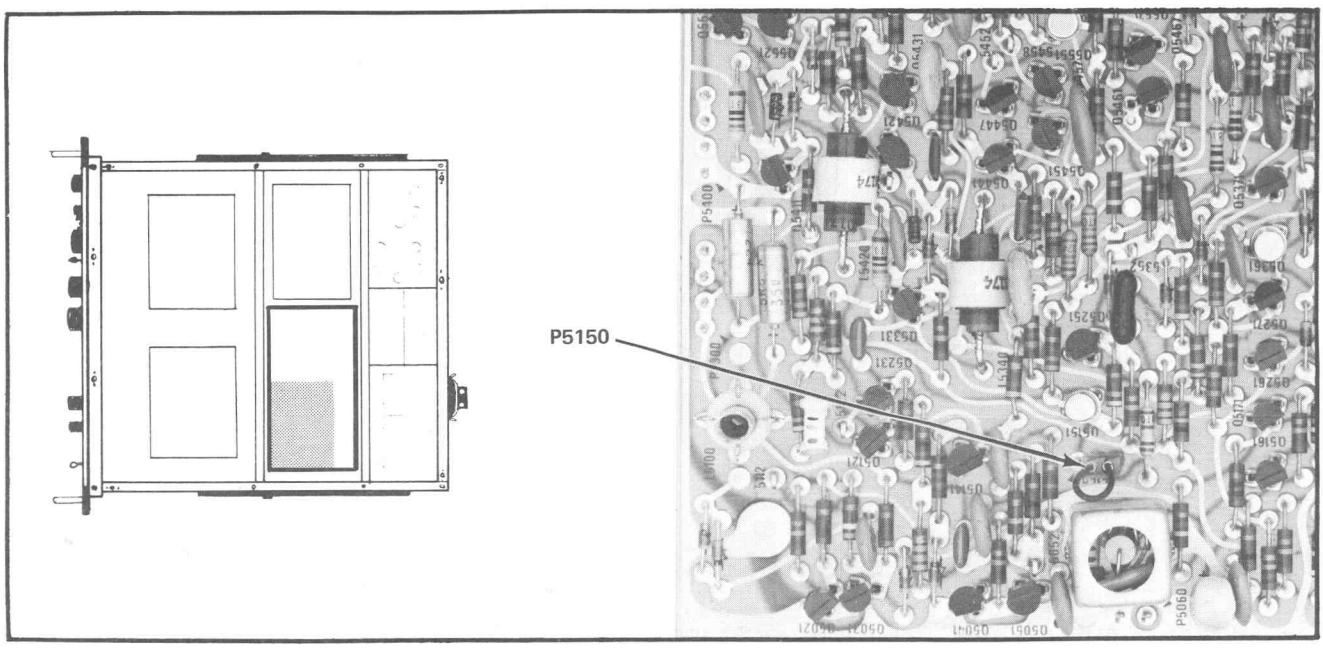


Fig. 2-12. Genlock circuit board showing location of P5150; Genlock Burst or CW (Residual Subcarrier).

for the WINDOW signal. These are (1) Bar Set, (2) Bar Reset, (3) Pulse Set, (4) Mod Pulse Set, and (5) Mod Pulse Reset.

b. Directly opposite the Signal, Area Affected, and Function columns for each possible connection found in part a, note the Wire and Connector Colour Code column, and the μs and Instant Timing column. This gives the colour code of the wire, colour code of the connector connected to the wire, time for a particular signal segment, and the instant which corresponds to the time of the signal segment. For connection (1) Bar Set, notice a wire code of 9-03, connector code of 1, 24 μs, and Instant 12. This indicates that a white wire with a black and orange stripe (9-03) and brown connector (1) is the only programming wire for the WINDOW Bar Set circuitry within the instrument. This 9-03-1 combination, when connected to Instant 12 (24 μs) on the Horizontal Timing circuit board will enable the Bar portion of the WINDOW signal to be generated.

c. Using part b as a guide, connect the remaining signal segment wires. These are: (2) 9-18-3 to Instant 24, (3) 9-01-0 to Instant 10, (4) 9-6-3 to Instant 6, and (5) 9-8-1 to Instant 8.

d. Check that the WINDOW signal is in agreement with that shown in Fig. 1-2.

Deleting Instants

In the above example, it was shown how to program signal segments. Now, assume the bar portion of the window signal is not required. Locate the 9-03-1 combination, connection (1), and connect it to one of the + Instants, P2730. The bar portion of the signal will now be eliminated.

1/2 Instants

For this discussion, refer to diagram 2b. Assume it is desired to generate the WINDOW signal such that (1) the bar portion of this signal starts at 25 μs rather than 24 μs as factory programmed, and (2) the 2T Pulse is desired to start at 21 μs rather than 20 μs as factory programmed.

1/2 Instant changes are accomplished by programming to the prior instant, delaying 1 μs, then applying the desired gate signal to the set or reset circuitry for that particular signal.

Proceed as follows:

a. To start the Bar at 25 μs (Instant 12.5) connect a wire between P2854-7 and Instant 12. This is the input to the 2 Input 1/2 Instant Delay.

b. To start the Pulse at 21 μs, connect a second wire between P2854-4 and Instant 10. This is the input to the 1 Input 1/2 Instant Delay.

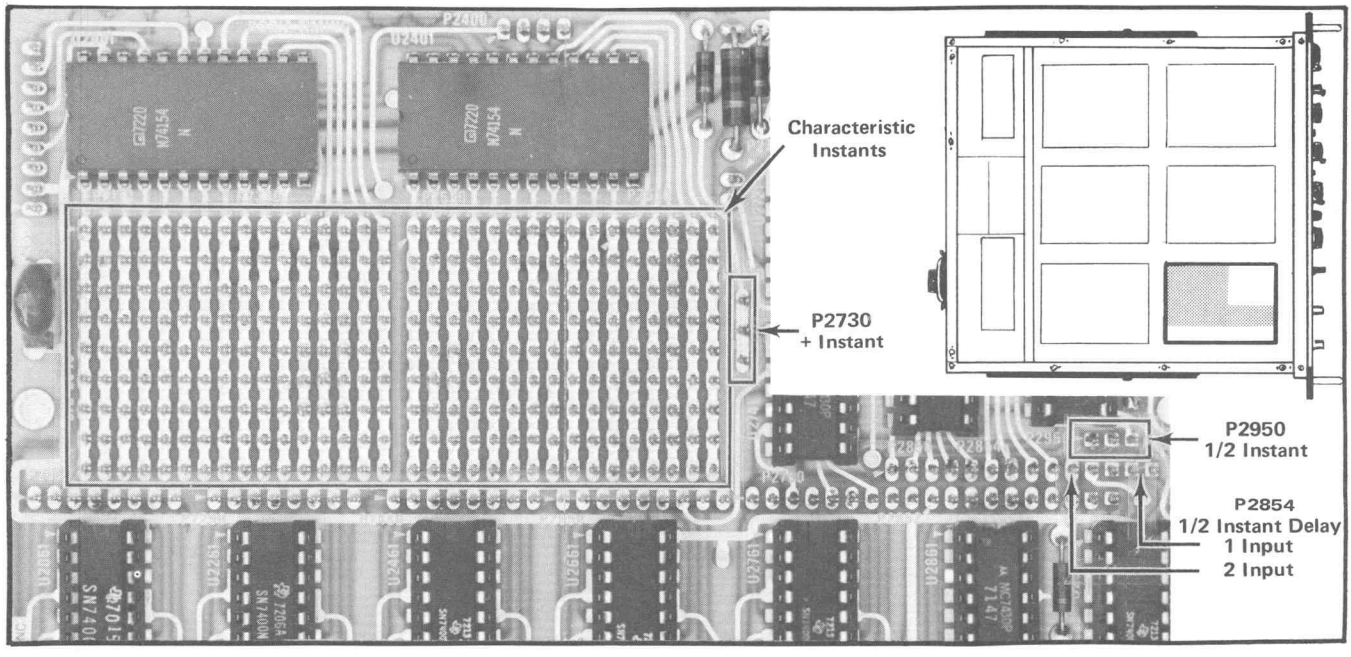


Fig. 2-13. Horizontal Timing circuit board showing locations of Characteristic Instants (use with Table 2-3); Horizontal Programming.

TABLE 2-3

Factory Horizontal Programming

Signal	Affected Portion	Function	Colour Code* Wire**	Connector	Timing μ Sec	Instant	Key To Table Instant	Wires
All,	H Blanking	Set	9-6	2	12	6	1	9-1
		Reset	9-34	2	62	31	2	9-2
	10 Step 1st level	Set	9-0	0	18	9	3	9-3
	2nd level	Set	9-02	0	22	11	4	9-4
	3rd level	Set	9-04	0	26	13	5	9-5
	4th level	Set	9-06	2	30	15	6	9-6
	5th level	Set	9-08	1	34	17	7	9-7
	6th level	Set	9-13	1	38	19	8	9-8
	7th level	Set	9-15	1	42	21	9	9-0
	8th level	Set	9-17	0	46	23	10	9-01
	9th level	Set	9-23	0	50	25	11	9-02
	10th level	Set	9-25	0	54	27	12	9-03
	Modulation	Set	9-5	0	10	5	13	9-04
		Reset	9-27	0	58	29	14	9-05
	Ramp	Set	9-0	1	18	9	15	9-06
		Reset	9-26	1	56	28	16	9-07
LINE 330 and LINE 17	Step Enable	Set	9-13	0	38	19	17	9-08
	1st level	Set	9-14	0	40	20	18	9-12
	2nd level	Set	9-16	0	44	22	19	9-13
	3rd level	Set	9-18	2	48	24	20	9-14
	4th level	Set	9-24	0	52	26	21	9-15
	5th level	Set	9-26	0	56	28	22	9-16
	Reset	Reset	9-34	0	62	31	23	9-17
	Pulse	Set	9-04	1	26	13	24	9-18
	Bar	Set	9-6	1	12	6	25	9-23
		Reset	9-02	1	22	11	26	9-24
LINE 330	Modulation	Set	9-06	3	30	15	27	9-25
		Reset	9-34	0	62	31	28	9-26
LINE 17	Mod Pulse	Set	9-06	0	30	15	29	9-27
		Reset	9-08	0	34	17	30	9-28
LINE 331	3 level 1st level	Set	9-7	0	14	7	31	9-34
		Reset	9-05	1	28	14	32/0	9-35
	2nd level	Set	9-0	2	18	9		
		Reset	9-05	2	28	14		
	3rd level	Set	9-02	2	22	11		
		Reset	9-05	0	28	14		
	Chroma Ref.	Set	9-07	0	32	16		
		Reset	9-28	1	60	30		
WINDOW (P & B)	Mod Pulse	Set	9-6	3	12	6		
		Reset	9-8	1	16	8		
	Bar	Set	9-03	1	24	12		
		Reset	9-18	3	48	24		
	Pulse	Set	9-01	0	20	10		
MULTIBURST	White Reference	Set	9-6	0	12	6		
		Reset	9-8	0	16	8		
	Black Reference	Set	9-8	2	16	8		
		Reset	9-01	2	20	10		
	Center Reference	Set	9-01	1	20	10		
		Reset	9-34	1	62	31		
	0.5 MHz	Set	9-03	0	24	12		
	1.5 MHz	Set	9-06	1	30	15		
		Reset	9-12	1	36	18		
	2.5 MHz	Set	9-12	0	36	18		
		Reset	9-15	2	42	21		
	4.0 MHz	Set	9-15	0	42	21		
		Reset	9-18	0	48	24		
	4.8 MHz	Set	9-18	1	48	24		
		Reset	9-25	1	54	27		
	5.8 MHz	Set	9-25	1	54	27		
		Reset	9-34	3	62	31		
NOISE	Insert	Set	9-03	2	24	12		
		Reset	9-18	3	48	24		

Colour Code*

0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

Example: A wire connected to INSTANT 24 has a color code of 9-18 and is read, BROWN-GRAY on WHITE. If this wire is the only connection to INSTANT 24, it will have a black connector. The second wire to INSTANT 24 will be 9-18/1 and read, BROWN-GRAY on WHITE with BROWN connector.

c. Disconnect the 9-03-1 combination from Instant 12 and connect it to P2950-1 (Output of 2 Input 1/2 Instant Delay). The Bar portion of the WINDOW signal will now be starting at 25 μs.

d. Disconnect the 9-01-0 combination from Instant 10 and connect it to P2950-2 (Output of 1 Input 1/2 Instant Delay). The pulse portion of the WINDOW signal will now be starting at 21 μs.

GLOSSARY OF TERMS

ACTIVE VIDEO LINES: All video lines not occurring in the vertical blanking interval.

APL: Average picture level. The average signal level, with respect to blanking level, during active picture scanning time, expressed as a percentage of the difference between the blanking and reference white levels.

BACK PORCH: That portion of the composite video signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLACK BURST: A signal consisting of composite sync and burst. Normally has setup.

BLANKING LEVEL: The level of the front and back porches of the composite video signal. Normally at 300 mV.

BREEZWAY: In PAL colour, the portion of the back porch between the trailing edge of the sync pulse and the start of the colour burst.

BURST FLAG: Pulses used to key out a portion of the 4.43361875 MHz sine wave subcarrier for use as a reference for the colour signal.

CHROMINANCE: That property of light which produces a sensation of colour in the human eye apart from any variation in luminance that may be present.

COLOUR BAR: A test signal, typically containing eight basic colours: white, yellow, cyan, green, magenta, red, blue, and black, which is used to check the chrominance functions of colour TV systems.

COLOUR BURST: In PAL colour systems, this normally refers to a burst of approximately 8 to 10 cycles of 4.43361875 MHz subcarrier frequency on the back porch of the composite video signal. This serves as a colour synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOUR SUBCARRIER: In colour systems, this is the carrier signal whose modulation sidebands are added to the monochrome signals to convey colour information; in PAL, it is a 4.43361875 MHz sine wave.

COMPOSITE BLANKING: This signal is composed of pulses at line and field frequencies used to make the return traces of a picture tube invisible.

COMPOSITE SYNC: The line and field rate synchronizing pulses (including the field equalizing pulses) when combined together form the composite sync signal.

COMPOSITE VIDEO: For colour, this consists of blanking, field and line synchronizing signals, colour synchronizing signals, chrominance and luminance picture information. These are all combined to form the complete colour video signal.

DIFFERENTIAL GAIN: The difference between (1) the ratio of the output amplitude of a small, high-frequency sine-wave signal at two stated levels of a low frequency signal on which it is superimposed and (2) unity.

DIFFERENTIAL PHASE: The difference in output phase of a small high-frequency sine-wave signal at two stated levels of a low-frequency signal on which it is superimposed.

EQUALIZING PULSES: Pulses of one half the width of the horizontal sync pulses which are transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulses. The purpose of these pulses is to cause the vertical deflection to start at the same time in each interval, and also serves to keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD: One half of a complete picture (or frame) interval, containing all of the odd, or all of the even, lines of the picture.

FIELD BLANKING: Refers to the blanking signals which occur at the end of each field. Also called vertical blanking.

FIELD FREQUENCY: The rate at which one complete field is scanned, normally 50 times a second in PAL.

FRAME: One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH: That portion of the composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding sync pulse. Normally 1.59 μs.

GEN LOCK: Subcarrier to burst lock.

H RATE: The time for scanning one complete line, including trace and retrace.

ITS: Vertical interval test signal. A signal which may be included during the vertical blanking interval to permit inservice testing and adjustment of video transmission.

LINE BLANKING: The blanking signal at the end of each scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY: The number of horizontal scans per second, normally 15,625 times per second in PAL.

LUMINANCE (Y): The amount of light intensity, which is perceived by the eye as brightness (referred to as 'Y').

PAL: Phase Alternate Line.

REFERENCE WHITE LEVEL: The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

SETUP: The separation in level between blanking and reference black levels.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by the subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

SYNC: An abbreviation for the words 'synchronization', 'synchronizing', etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The colour sync signal is known as the colour burst.

VERTICAL BLANKING INTERVAL: The blanking portion at the beginning of each field. It contains the equalizing pulse, the vertical sync pulses, and ITS (if desired). Presently 18-21 lines duration.

VERTICAL DRIVE: A pulse at field rate used in TV cameras. Its leading edge is coincident with the leading edge of the vertical blanking pulse.

SECTION 3
CIRCUIT DESCRIPTION

General

This section of your manual describes the electrical operation of circuits within the 148. The description is organized with respect to the schematic diagrams.

The 148 can be considered as in Fig. 3-1. Basically, the 148 consists of (1) A relay to provide bypass in the event of loss of power or when the instrument is in the bypass or auxiliary modes, (2) Sync and Subcarrier processing circuits to detect synchronization information, (3) Timing circuits to provide gate signals used for generation of the output signals, (4) Test signal Generator to generate the various output signals, (5) Program Control Switching to allow the operator to select the mode of operation, (6) Electronic Switches to route all signals to the proper outputs at the proper time, and (7) Output Amplifiers to provide sufficient current to drive the outputs.

Block Diagram

The block diagram relates the schematic circuitry to the operation of the 148, and is a transition between Fig. 3-1 and the schematic diagrams.

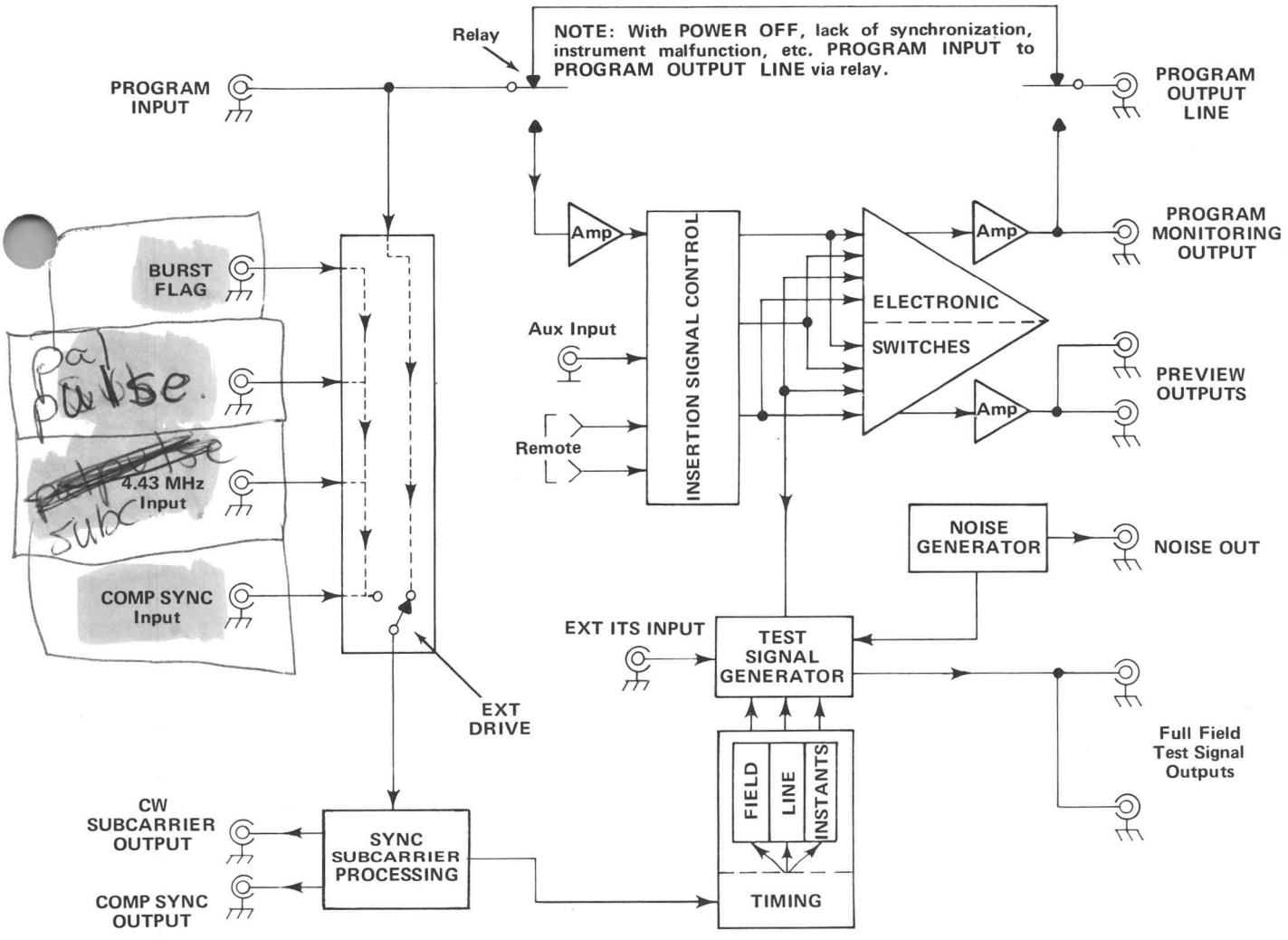


Fig. 3-1. Basic block diagram of the 148.

DIAGRAM 0a and 0b

The circuitry shown on Diagram 0a (Program Line Amplifier) is used to condition the input signal applied to the PROGRAM INPUT for further processing (required for insertion of signals) and selects the mode of operation. The circuitry shown on Diagram 0b (ITS Inserter) routes internally generated and externally applied signals during selected intervals so that a composite of each is available at the PROGRAM OUTPUT LINE, PROGRAM MONITORING OUTPUT, or PREVIEW OUTPUT connectors.

Relay

The relay circuitry is used to bypass the program signal to the PROGRAM OUTPUT LINE in the event of circuit failure, loss of power, etc., or apply the program signal to the active circuits within the 148 for processing.

Bypass Indicator

This stage, consisting of emitter follower Q580, detects the condition of the bypass relay. The output of Q580 will be at or near ground when the relay is energized. The output will be around +5 volts if the relay is not energized. This information is used for three purposes. First, the output which goes to U761-6 turns off the program switch and prevents any signal from entering the program output amplifier. This ensures that there is no signal present on the open contacts of the bypass relay which might cause crosstalk into the program lines. Secondly, the output of this stage is used, as shown on Diagram 4, to operate the bypass indicator lamp. The third use of this signal relates to the auxiliary mode of operation. In this mode of operation the timesharing of the internally generated signals and the incoming signals is reversed. A high output from the Bypass Indicator stage enables U4381A to reverse the ITS Key timing.

Program Amplifier

The Amplifier stage is an AC coupled operational amplifier with unity gain or variable gain (front-panel LEVEL) of the program signal. AC coupling removes any DC component that may be applied via the PROGRAM LINE IN.

Q540 provides constant current for emitter-coupled amplifier Q510-Q520. Current through Q520, set by R9205 (LEVEL) or R505 (dependent upon the setting of S9205, UNITY GAIN/VAR), flows through R625 (Rf of operational amplifier Q620-Q630) to set the overall circuit gain. The signal at TP820 is applied to the ITS switches (after DC restoration). R720 and CR720 balance out any residual differential phase that may be present in the program amplifier. CR720 is installed either forward or backward, depending on the nature of the differential phase that is present. Refer to the Calibration Procedure for further information.

Back Porch Generator

The stage is used to generate a pulse during back porch time to drive the Back Porch Clamp circuitry.

Q905, normally on, is driven by composite sync (negative-going). On the trailing edge of each sync pulse, Q905 turns off (current shunted via Q900), producing a pulse which is differentiated by C910 and R926. When Q905 turns back on, the differentiated pulse turns Q920 (normally on) off. A negative-going pulse (which has been delayed from sync), is obtained at the collector of Q920, such that during back porch time, the circuit DC-restores the signal appearing at TP801. The pulse-forming circuitry acts like two monostable multivibrators. The first one, consisting of Q900 and Q905, form the delaying time necessary following the trailing edge of sync. The second monostable consists of Q905 and Q920; it forms the actual clamping pulse.

Back Porch Clamp

Q820 is the active circuit element of this stage. During back porch time, it is biased on, and effectively grounds TP801. This DC-restores the signal via C804 in the amplifier stage.

Program Control Switching

Consisting of S9212 and S9213, this stage selects the mode of operation: PROGRAM, PREVIEW, or BYPASS, and REMOTE, AUX, or LOCAL.

ITS Switches

U761 and U861 are used to route the program signal (or auxiliary signal in AUXILIARY mode) to the Output Amplifiers, except when ITS is inserted during the vertical interval. During ITS time, the switches route internally generated signals to the Output Amplifiers as programmed ITS.

Basically, the circuitry acts like two double pole-double throw switches. In one position, signals applied to pins 2 and 15 reach the differential output, pins 12 and 13. In the other position, signals at pins 7 and 10 reach the output. Switching between the two channels of each switch is dependent upon the condition of pin 4. Signals reaching the output of each switch are also dependent upon the condition of pin 6 (if high, no output will be obtained). Thus, the incoming program signal (or auxiliary) is applied to one channel, the internal signal to the other; dependent

upon Program Control Switch settings, a combined output is obtained.

ITS Switch Control

As discussed above, ITS switching is dependent upon the condition of U761 pin 4 and U861 pin 4. This stage is used to steer a control signal to pin 4 of each switch so that insertion may occur. Q560, Q570, and Q658 are the active elements of this stage.

For the discussion that follows, assume that the PREVIEW mode of operation is selected, and that an ITS is internally programmed to appear during the vertical interval. Under these conditions, the signal at the PROGRAM OUTPUT LINE and MONITORING OUTPUT is the same signal applied to the PROGRAM INPUT; the signal at the PREVIEW OUTPUTS is the PROGRAM INPUT signal, plus the internally generated and inserted ITS. For these conditions to exist, pin 4 of U761 (program switch) must be held low at all times to inhibit insertion in the program channel. That is, in the preview mode of operation the ITS key signal should be steered into the preview switch and away from the program switch. In addition, pin 4 of U861 (preview switch) must be held low, except during ITS time.

S9212 places a ground on P591-6. CR585 and CR588 are forward biased, shutting off Q560 and Q570. With Q560 and Q570 off, pin 4 of each ITS gate is low and only the program signal appears at the respective outputs. During ITS time, an ITS key pulse (via P591-3) reverse biases CR588 to switch current through Q570. Pin 4 of U861 goes high, allowing the ITS (via pin 7 of U861) signal to be routed to the PREVIEW OUTPUTS.

In the PROGRAM mode it is desired to steer the ITS key signal to both the program switch and the preview switch. In this mode the ground is removed from P591-6. Q560 therefore is able to conduct, but its collector does not go positive because Q658 is biased on during the low state of the ITS key signal. When the ITS key signal goes positive and cuts off CR588 current flows through Q570. This places a high state voltage on pin 4 of U861, the preview switch, and also through CR664 onto the base of Q658 which acts as an emitter follower to deliver the high state voltage to pin 4 of U761. Therefore, both the program switch and the preview switch are furnished with the ITS key signal and Insertion Test Signals will be seen at the PROGRAM OUTPUT LINE and the PREVIEW OUTPUT.

Should interruption of the program signal occur, a detector elsewhere in the instrument senses the absence of an incoming signal and at that time develops a high state voltage, which is delivered to P501-2 by way of CR651. This signal cuts off Q658, thus allowing the current through Q650 to hold a high state voltage on pin 4 of U761. This steers the internally generated full field test signal into U761; whichever full field test signal has been selected on the front panel will then appear at the program output. The link from the program loss sensing circuit to P501-2 passes through the remote plug on the rear of the instrument. If this feature is not desired, the connecting jumper may be removed.

Output Amplifiers

The output of both U761 and U861 are push-pull signals. Each output amplifier consists of a differential pair followed by a feedback operational amplifier. The differential pair converts the push-pull signal from the program or preview switch to a current. This current drives the input summing junction of the operational amplifier. R868 and R978, Rf for each amplifier, set the gain of each stage. These operational amplifiers provide the low impedance necessary to drive the PROGRAM OUTPUT LINE, MONITORING OUTPUT and PREVIEW OUTPUTS.

Preview Indicator

Q565, an emitter follower, provides drive for the PROGRAM and PREVIEW lamps.

DIAGRAM 1

The Vertical and Horizontal Counter circuitry synchronizes the 148 to the incoming program composite sync (or external drive signals), and generates all timing signals required for operation of the 148.

Horizontal Integrator, AFC Samples, 1 MHz Oscillator, 64 μs Counter, and Delayed Feedback.

A 1 MHz oscillator generates a pulse that is counted down to the line rate. The line rate gate is then compared to the external composite sync. Any timing error between these two signals will produce an error voltage to change the oscillator frequency. This action keeps the 64 μs counter in step with the external sync.

1 MHz Oscillator. Q1880 and Q1881 are the active components for the 1 MHz oscillator. CR1848 and L1870 are the frequency-determing components. Sustaining feedback is provided via C1992 and C1996. The output of the oscillator, collector of Q1881, consists of positive-going pulses (limited sine-wave), which are then used to toggle the 64 μs Counter.

64 μs Counter. U1290, U1390, and U1590 form the stage. Each counter is level sensitive (positive) and divides the 1 MHz toggle pulses in a divide-by-2, divide-by-4,. . ., divide-by-64 sequence.

Delayed Feedback. U1790C combines three of the 64 μs Counter outputs to produce a negative gate, approximately 8 μs wide, each horizontal line. During the 8 μs negative interval, this pulse disconnects CR1890, which allows C1974 to charge toward +15 volts (from 0 volts) at approximately 0.5 V/μs. A ramp of approximately 4 volts and 8 μs duration is thereby generated and may be viewed at TP1985.

The ramp is then compared against the setting of R9209 (INSERT DELAY) and R1978 (Sync Delay) by voltage comparator Q1930 and Q1940. When the ramp voltage exceeds the delay voltage, Q1930 is turned off and a ringing pulse is developed across L1964. The positive portion of this pulse is applied to the base of Q1920.

AFC Sampler

Q1820 and Q1920 form the AFC Sampler. When Q1920 is turned on, Q1820 acts as a gate which allows the voltage obtained by the ramp in the Horizontal Integrator to be transferred to the memory capacitor C1828.

Horizontal Integrator

During sync time, this stage produces a ramp that is sampled to control the 1 MHz Oscillator. Composite sync is coupled to switching pair Q1900-Q1910. This switch, during sync time, allows current determined by R1919 to charge C1912 via Q1910. This produces a positive (approximately 3 V/μs) ramp, made linear by Q1911. At approximately 4.7 volts positive, Q1901 is saturated to clamp the ramp, preventing breakdown of Q1820 in the AFC Sampler circuit.

At the end of sync time, Q1900 is turned on, and current via R1918 causes the ramp to go in a negative direction toward 0 volts at an approximate rate of 2.5 V/μs, made linear by Q1911. Ramp voltage at sample time is transferred via the AFC Sampler stage to the 1 MHz Oscillator, which brings the 64 μs Counter into step with the external sync.

Vertical Integrator

During the vertical serration pulses, the vertical integrator produces a ramp which is peak-detected and used to set the 625 Line Counter and Field Recognition circuits. This integrator is similar to the horizontal integrator except for circuit values, and consists of Q1700, Q1720, Q1800, and Q1801.

On the last vertical serration pulse, Q1720 is biased on, producing one negative pulse per field to drive the 625 Line Counter and Field Recognition circuit.

Field Recognition

U1770A and D, and Q1750 are the active components of the set-reset stage, and identify fields 1 and 3, fields 2 and 4.

The circuit is driven by the field pulse (obtained in the Vertical Integrator) and by the 8 μs gate pulse (via the 64 μs Counter) each line. When the 8 μs gate and field pulse are coincident the set-reset stage recognizes fields 1 and 3 and changes state; no coincidence with the pulse is required for fields 2 and 4 recognition. See Fig. 3-2 for timing waveforms.

Clock

This stage is driven by pulses corresponding to instants 15 and 31 (see Operating Instructions or Diagram 2_a for details). The pulses are used to toggle the 625 Line Counter.

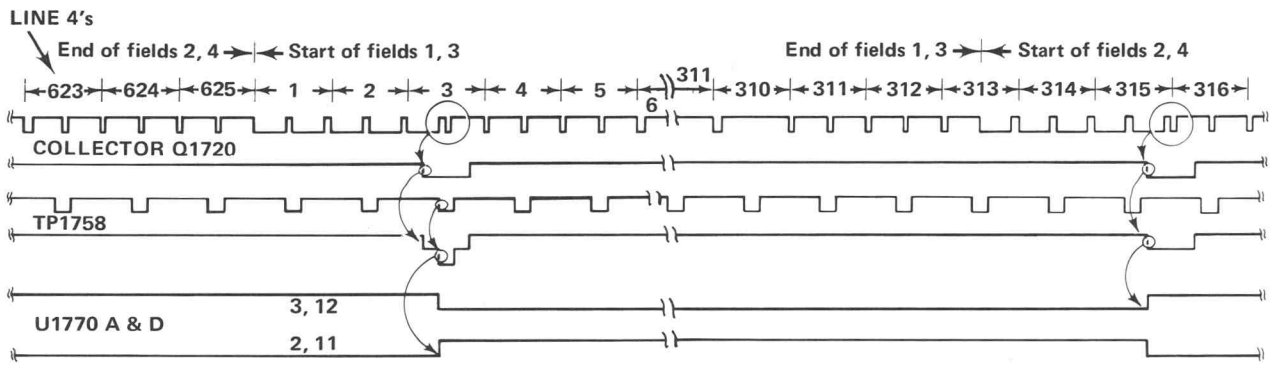


Fig. 3-2. As shown Field Recognition Timing waveforms.

625 Line Counter

The counter generates the various timing gates required for one-half line offset used in interlace scanning. The counter is initially set to a count of 399 by a pulse obtained in the Vertical Integrator. It is then toggled from the Clock stage, counting to 1024 in a divide-by-2, divide-by-4,. . ., divide-by-1024 sequence. On the 1024 count, the counter is reset to a count of 399 and the sequence is repeated. (1024 − 399 = 625.) However, only the initial preset of the counter is from the Vertical Integrator as the counter is self-setting.

Matrix

The matrix is used to combine the various timing signals from the 625 Line Counter into timing-gate pulses. The first signal, starting from the top of the matrix section, is found on P1090-4. This is the signal that controls the field rate square wave. This signal is normally at a high state but goes to a low state between lines 65 and 270 and between lines 378 and 583. The next signal developed by the matrix is the 7-1/2 line key-out signal. This signal is used in the development of the composite sync signal and corresponds to that portion of time during the vertical synchronizing interval when equalizing pulses and serrated pulses are present. This signal appears on pins 1 and 2 of P1390. The vertical blanking signal is present on pins 8, 9, and the inverted form on pin 10, P1690. A fourth signal not present in any output signal but required for the internal operation of the insertion line counter is present on pin 9 of P1090. The fifth and last signal (count 613) developed by the matrix is used in the development of the Bruch-burst blanking interval. This signal appears on pin 1 of P1090. Count 613, as well as the VERT BLANKING signal and the 7-1/2 LINE KEY-OUT signal, may be disabled or inhibited when the NORMAL/LINE RATE ONLY switch is in the LINE RATE ONLY position, with the PROGRAM-PREVIEW-BYPASS switch in BYPASS.

ITS H Blanking

The ITS H Blanking is developed in the 64 μs Counter. It is narrower than the horizontal blanking pulse. The extra width of the unblanking portion of the signal allows the ITS key pulse to change channels, via the preview or program switches, slightly before any test signal transition takes place then change back slightly after the final transition that takes place.

U1370B senses all 4 high inputs 2 μs before the end of each horizontal line and produces a low output. This low output is applied to the set input of R-S flip-flop U1770B and U1770C, setting its 1 output high (5 V), and toggling the Bruch-burst blanking counter on Diagram 8.

U1790A senses all three high inputs 4 μs after the start of each horizontal line, and resets the R-S flip-flop. The high on the 0 output enables ITS key on Diagram 4 and the subcarrier phase control on Diagram 8.

DIAGRAM 2a and 2b

The Horizontal Timing circuitry combines the various signals generated by the Vertical and Horizontal Counters into timing pulses required to generate all test signals.

Instant Decoder

U2001 and U2041 are used to decode the various outputs from the 64 μs Counter. Decoding provides 32 outputs (characteristic instants), 2 μs apart

$$\frac{64.0\ \mu s}{32}$$

each having a 1 μs negative-going pulse once each line.

Set-Reset Circuits

There are twenty-three set-reset circuits available on the horizontal timing board. The event associated with any given set-reset circuit is labled on Diagram 2_a directly above the row of connectors that carry the input signals to the set-reset circuits.

Each set-reset circuit is programmed in the instant decoder matrix. The characteristic instant associated with the command, e.g. set or reset, is indicated above the input signal line. The times indicated are factory programmed.

Multiburst Width

This stage enables the Multiburst generator. U2741 senses low inputs from the various burst R-S flip-flops and triggers the monostable multivibrator U2811A. Pin 1 of U2811A is negative edge sensitive when pin 2 is enabled by a high from Diagram 4. U2931C provides negative triggers during every horizontal line, but a high enable from Diagram 4 occurs only on the line and field that are programmed on the ITS line and field matrix. C2730, R2715, and R2720 are the timing components for U2811A. R2715 is adjusted for 3.9 μs pulse width. The low output pulse at U2811A pin 4 is inverted by U2911B, a low input or gate.

LINEARITY Staircase Logic

The full line linearity signal can be either a 10 step or a 5 step staircase or a ramp. The timing information for this signal is developed from the characteristic instant matrix and delivered to the inputs of or gates U2831 and U2961C. Each characteristic instant corresponds to a riser on the 10

step staircase. The timing information for the 5 Step staircase signal is derived from the 10 Step timing information through the use of a divide-by-2 counter located on the staircase circuit board.

1/2 Instant Delay

This stage, consisting of U2931E and U2961D, is used to shift any characteristic instant 1 μs.

U2931E and U2961D invert negative-going (or low level) pulses from the INSTANT DECODER. The inverted (positive-going or high level) pulses are differentiated by C2936 or C2958. The negative-going portion of the inverted pulse is thus delayed 1 μs from the negative-going edge of the characteristic instant.

Modulation Logic

This stage provides a pulse which enables modulation to be inserted on the LINEARITY test signal or LINE 330 signal. U2981A generates a low enable output when pin 3 senses a high LINEARITY enable and pin 2 senses a high from the LIN MOD R-S flip-flop.

U2981B generates a low enable output when pin 6 senses a high LINE 17/330 enable from U2931D and pin 5 senses a high from the LINE 330 MOD R-S flip-flop.

Staircase Logic

This stage provides the timing necessary for the staircase portion of the LINE 17 SIGNAL or the LINE 330 SIGNAL.

U2981C generates a low enable output when pin 9 senses a high LINE 17/330 enable and pin 8 senses a high from the LINE 17/330 LIN R-S flip-flop.

LINE 17/330 Five Step Timing

Or gate U2861 senses 5 characteristic instant inputs. Each of these instants corresponds to the time of a riser in the staircase signal used on both the LINE 17 and LINE 330 test signals.

Pulse Timing

This circuit provides pulse timing for the T and 2T pulses used on the LINE 17 and LINE 330 test signals and the WINDOW full field test signal.

U2721 is an and/or invert gate. Pin 8 goes high when pin 9 or 10 and pin 13 or 1 are low. Pin 10 is low for LINE 17 or LINE 330, and pin 1 is low for WINDOW. Pins 9 and 13 sense lows at characteristic times 10 and 13.

U2931F inverts the output from U2721 pin 8 to provide a low output.

Mod Pulse Timing

This stage provides the timing pulses required for the modulated sine-squared pulse. U2721 provides a high enable output to Diagram 9 at pin 6. Operation of the and/or invert gate is similar to the pulse timing circuit.

U2811B is not used. R2706 holds pin 11 low, disabling the single shot and holding pin 12 high.

U2911B is part of the Multiburst Width circuit.

Bar Timing

This stage provides the switching pulse for the bar, either T or 2T.

U2911A generates a low enable output on pin 1 when pins 2 and 3 are both high. Pin 2 senses a high from the Window Bar Timing set-reset multivibrator on Diagram 2_a. Pin 3 senses a high for WINDOW full field signal, or for WINDOW insertion test signal.

U2911C generates a low enable output for LINE 17/330 insertion test signal. Pin 8 is high for LINE 17/330, and pin 9 senses a high from the LINE 17/330 BAR R-S flip-flop.

DIAGRAM 3a & 3b

The circuitry on Diagram 3_a and 3_b is used to generate and amplify the NOISE test signal and to generate the LINEARITY and FLAT FIELD test signals.

Noise Generator

This stage uses the thermal characteristics of two resistors, R3285 and R3383 to generate the noise.

The generated noise amplitude (approximately 60 μV) may be computed using the formula: $e = \sqrt{4KTR\Delta f}$, where K = Boltzmann Constant, T = 300 °K, R = parallel combination of R3285-R3383, and Δf = 5 MHz.

Noise Preamp

Q3360-Q3370 and Q3240-Q3250 are operational amplifiers, each having a gain of approximately 30, as determined by the ratio of R3271 to R3371, and R3341 to R3343, respectively. This provides approximately 70 mV of noise at the collector of Q3240. C3251 and R3270 affect the low frequency cutoff so that the noise spectrum is flat (within the tolerance listed in Section 1).

Noise Amplifier

This stage provides front-panel (NOISE LEVEL dB) DC control of the noise signal.

The 1 dB switch (S9240) located on the front panel controls the current through the emitters of U3100A and B, which are connected as diodes. The impedance between pin 6 of U3100C and pin 9 of U3100D is set by this current. E.g., increase current reduces the impedance, and less signal is allowed to pass through the noise amplifier.

The 10 dB switch provides a forward bias source for Q3040, Q3050, Q3060, and Q3070. Turning on one of these transistors grounds its collector. As these transistors are connected to a resistor string composed of R3140, R3163, R3171, and R3183, they set the impedance to ground at the base of Q3130. The amplitude of the signal seen by Q3130 is controlled by this impedance. Q3130 and Q3110 are emitter followers to provide low impedance outputs.

Field Square-Wave

This stage ensures that the Field Sq. Wave signal begins and ends at the beginning and end of horizontal lines in all 4 fields. The Field Sq. Wave signal input to this circuit comes from the matrix circuit on Diagram 1 and is offset 1/2 line in fields 1 and 3.

U3585A is an edge-triggered D flip-flop. The data input (pin 2) is programmed by a high during lines 65 through 270 and 378 through 583, and a low during the remaining lines. Pin 3 is triggered by the positive portion of the H blanking signal from Diagram 8. The set and clear inputs are inhibited by R3491. The output on pin 5 is the FIELD SQ. WAVE timing signal to the APL circuit.

Window

This circuit is similar to the Field Square-Wave, except that it's output is the WINDOW enable to Diagram 4, ITS and FF LOGIC.

Bounce Generator

This circuitry consists of a modified Bowes Oscillator (Q3890 and Q3880) which is front-panel controlled (RATE). This allows the oscillator period to be changed from ≈ 1 to greater than 10 seconds. The output of the bounce oscillator is used to control the data input of flip-flop U3855B. This flip-flop is clocked by horizontal blanking, so that the bounce transitions will take place coincident with the start of a line. The outputs of this flip-flop are used to control nand gates U3835D and U3735C.

APL

This stage consists of four current switches that set the level of the FLAT FIELD or FIELD SQ WAVE test signal. U3735D generates a low output when FLAT FIELD ENABLE and H BLANKING (pins 12 and 13) are both high, disconnecting CR3921, CR3821, and CR3723. This permits current from Q3825, Q3820, or Q3720 to flow through CR3911, CR3811, or CR3711, and through R3814 to circuits shown on Diagram 7_a. Q3825 sets BLACK current when the output from U3835D is low, disconnecting CR3823. Q3820 sets WHITE current when the output from U3735C is low, disconnecting CR3725. Q3720 sets VAR current when S9275 is in the VAR APL position, disconnecting CR3721. A high output from U3735D shunts current from these transistors and disconnects CR3911, CR3811, and CR3711, disabling FLAT FIELD signals. Q3920 sets FIELD SQ WAVE current when pin 1 of P3801 is low, pin 8 of P3800 is low, and the output of U3835C is low. S9290 (% PEAK WHITE) selects the current setting resistors for FIELD SQ WAVE.

Linearity Modulation Amplitude

This stage is a programmable current switch (Q3420 and CR3411) that provides sufficient current to the modulator for either 140 mV or 280 mV subcarrier modulation on the LINEARITY test signal.

Control Logic

This stage combines timing and gate signals for the control of staircase and ramp generation for the LINEARITY and LINE 17/330 signals.

U3735A generates a low output on pin 3 to enable the integrator circuit when pins 1 and 2 are both high. U3735B produces a high output on pin 6 when either pin 5 is low for LINE 17/330 staircase or pin 4 is low for LINEARITY.

U3775A produces a negative-going pulse on pin 3 when pin 2 is high and pin 1 is pulsed high. U3755C inverts the low pulses from U3875C.

U3875C produces negative-going pulses when pin 8 or pin 9 senses positive pulses from circuits shown on Diagram 2 $_{b}$. U3875B generates a high output on pin 4 when pin 5 U3875B is low and S9253 is in the 10 STEP position, grounding pin 6.

U3775A produces positive-going pulses for either 5 STEP LINEARITY or LINE 17/330 signals. U3855A divides 10 STEP timing by 2 for 5 STEP LINEARITY. U3875A pin 1 is high to enable U3855A when pin 2 and 3 are both low.

U3835A produces a low on pin 3 for RAMP when pins 2 and 1 are both high. U3875D is high on pin 13 when pins 11 and 12 are both low (S9253 grounds pin 11 in RAMP position).

When P3760 is reversed, the staircase portion of the LINE 17/330 signal is replaced by a ramp. U3775B is inhibited by grounding pin 4, U3835A pin 1 is driven by U3775D pin 11, and U3875D pin 13 drives U3775B pin 3.

Integrator

This stage consists of a Miller Integrator and a reset circuit; it generates ramp and staircase waveforms.

The integrator consists of Q3440, Q3430, and Q3530. C3441 and C3443 provide the feedback for integration.

The reset circuit consists of Q3520, Q3510, Q3600, Q3540, CR3531, and CR3533. When U3735A produces a low on pin 3, CR3533 conducts and disconnects CR3531. Q3520 increases conduction and shuts off Q3540. The integrator can now accept drive from either the 10 Step, 5 Step, or Ramp drive sources.

When Ramp is selected, a constant current is drawn from the Integrator input (gate of Q3440). As the gate of Q3440 is drawn positive the source follows. Q3430 inverts and amplifies, initiating a negative ramp. Q3530 couples this negative excursion to feedback capacitors C3443 and C3441, and also provides a low impedance output.

When U3735A pin 3 goes positive, Q3520 shuts off, and Q3510 conducts, turning on Q3540. Q3540 conducts through CR3531, resetting the integrator and disconnecting CR3533.

Q3600 clamps the base of Q3540 at +0.5 V. Feedback from the integrator output to the emitter of Q3540 maintains the quiescent 0 V output level.

10 Step Drive

Each time U3775A pin 3 pulses low, Q3470 conducts and discharges C3470 and C3461 through Q3450. The current demanded by Q3450 drives the integrator. For each pulse, a negative step is generated by the integrator.

5 Step Drive

This circuit is similar to the 10 Step Drive circuit, except that C3565 and C3473 have a parallel capacitance twice that of C3470 and C3461, so that the 5 Step staircase is the same amplitude as the 10 Step staircase.

Ramp

This circuit demands a DC current from the Integrator for Ramp generation. When U3835A pin 3 goes low, U3755D pin 8 goes high, disconnecting CR3651. R3616 and R3621 set the DC current demanded by Q3645 from the integrator, setting a linear ramp rate. P3620 places R3641 in parallel with R3721 to change the ramp rate when a ramp is programmed on the LINE 17/330 signal. R3623, CR3641, CR3551, and R3553 set the bias voltage on Q3450, Q3545, and Q3645.

DIAGRAM 4

The circuits on Diagram 4 determine which lines will contain the test signals. Test signals may appear on all lines, in which case it is referred to as a full field test signal; or they may occur on selected lines during the vertical blanking interval, in which case they are referred to as insertion test signal lines. The outputs from the circuitry on Diagram 4 are enabling signals directed to the individual test signal generating circuits.

Line Counter

The line counter establishes gating signals corresponding to each of the available insertion test signal lines.

U4151 is a 4-bit binary counter. The trigger input is a characteristic instant pulse corresponding to time 0 and occurs once every line. The counter is reset to 0 at line 623-1/2 or 311 and is inhibited until just before line 8 or 321. Counting begins upon receipt of the next trigger pulse.

U4351 converts this binary code to decimal output. Each output is a low pulse of one line duration, beginning with line 11 of one field and line 324 of the other. Both the G1 and G2 inputs must be low for U4351 to operate. The G2 input is connected directly to the vertical blanking signal, so that the decoded insertion test signal line pulses will be present only during the vertical blanking interval. The G1 input is enabled by the ITS Nonsynchronous Inhibit circuit.

ITS Nonsynchronous Inhibit

This circuit prevents any ITS from being inserted into the vertical interval, should loss of vertical sync occur.

U4381B and C form a R-S flip-flop which, when set, produces a high output on pins 6 and 9 and a low output on pins 5 and 8. The high output enables the ITS Key circuit and the low output enables the G1 of U4351. When reset, these outputs are inverted (low on pins 6 and 9, high on pins 5 and 8), inhibiting the ITS Key and U4351.

Vertical blanking is capacitively coupled into the reset input (pin 10) through C4387 to inhibit the ITS line decoder at the start of every vertical blanking interval. A negative pulse from the Vertical Integrator shown on Diagram 1 sets the flip-flop when incoming vertical sync has been processed for the counters.

A LOW FOR NON SYNC from a circuit shown on Diagram 9 $_a$ appears at U4381C pin 10 when any incoming synchronizing signals are missing, resetting the flip-flop, and inhibiting the line decoder and ITS Key.

ITS Line and Field Matrix

This stage selects lines and fields for insertion of the various ITS.

Each row of pin pairs corresponds to a particular test signal as labeled. Each column corresponds to a particular line. The 3 columns at the extreme right correspond to fields as labeled. Programming plugs placed on the matrix connect selected line and field information to and gates U4621C, U4621D, U4621B, U4621A, U4641C, U4641D, and U4641A.

When one of the and gates senses a low on both inputs (line on one, field on the other) the output goes high. The inverter makes this a low enable for the ITS Key and the ITS or Full Field circuit.

ITS Key

This circuit developes the SWITCH CONTROL signal for Diagram 0 $_b$. A high output is present on pin 8 of U4581C when either pin 10 is low for AUX or pin 9 is low for insertion of test signals. A low output is generated by U4551D on pin 11 when U4551D pin 13 is high, U4551C pin 10 is high, and any input to U4821 is low.

Full Field Logic

This circuit provides for the front panel selection of full field test signals, and consists of 6 identical circuits, plus one that is unique to WINDOW. U4881 pin 6 is high when pins 2 or 3, and pins 4 or 5 are low. Pins 3 and 4 are grounded by the FULL FIELD SIG switches in the LINE 330 position. Pins 2 and 5 are switched high and low by the Alternate Switching Logic circuit shown on Diagram 9 $_b$. U4851B generates a low enable output when pins 4 and 5 are both high.

U4741F and U4651B provide for BAR ENABLE and PULSE ENABLE signals for the full field signal WINDOW.

ITS or Full Field

This stage receives either low ITS timing pulses from the ITS Line and Field Matrix, or low full field timing gates from the Full Field Logic circuit. Either input is inverted and passed on to the Control Logic circuit as a high.

Control Logic

This stage processes the enabling signals from the ITS or Full Field circuit and generates the required enabling signals for the test signal generators.

A low, enabling LINE 330, appears on U4641B pin 4 when pin 5 or pin 6 is high. U4841C generates a high MOD INHIBIT on pin 8 when either pin 9 or pin 10 is low to shut off the Subcarrier Oscillator during the noise measurement mode. Pin 11 of U4841D produces a high MOD PULSE ϕ signal when either pin 12 or 13 is low. This high signal is then applied to the Subcarrier Phase Control circuit on Diagram 8 as an enable during modulated pulse time. U4741B inverts the high from U4751D for a low LINE 331 ENABLE. NOISE KEY OUT is a low generated by U4581A on pin 3 when pins 1 and 2 are both high. PED and NOISE ENABLE is a low appearing on pin 6 of U4581B when pins 4 and 5 are high. U4841A generates a high BAR ENABLE when pin 1 is low or when pins 4 and 5 of U4841B are high.

Noise Logic

There are three modes of use for the 148 noise measurement circuits. The first mode is deletion of any information on one full line of insertion test signal. This is useful where noise is to be measured at a downstream point, but incoming noise from upstream points is to be deleted. The second mode is the insertion of a measured amount of noise on the center half of an insertion test line. The third mode, similar to the second, is the insertion of a measured amount of noise during the center portion of all active lines in the field. This is available at the PREVIEW OUTPUTS and is useful for making noise measurements on video tape recorders or other places where a noise measurement during the vertical interval is not meaningful or desired.

Deletion. When full line deletion is required, the desired line is programmed in the ITS Line and Field matrix. A negative-going pulse is then applied to pin 1 of U4551A. The resulting high output is applied to pin 13 of U4581D, a high input and gate. S9225, the front panel NOISE switch, produces an open circuit at P4290-4, allowing U4581D pin 12 to go high through R4580. The resulting low at U4581D pin 11 causes a high at U4481B pin 6 which is then applied to U4481A pin 2. U4481A is a high input and gate. U4481A pin 1 receives its required high when the PREVIEW mode is selected or when the vertical blanking signal is at a low state during the insertion test signal period. When U4481A pins 1 and 2 are both high a low ITS key is developed at pin 3.

Half Line Insertion. When a measured amount of noise is desired during the center portion of a particular insertion line, S9225 grounds pin 5 of U4281B. This inhibits the path just described and enables the path consisting of U4281B and U4481C. Pin 6 of U4281B must also be low which is the case when noise is called for as an insertion signal or as a full field signal. The full field interval is unimportant in this mode since it is prevented from affecting the ITS key by the vertical blanking signal on pin 12 of U4481D. The output of U4281B is now seen to be a high applied to pin 9 of U4481C. Pin 10 of U4481C is high during the center portion of a scanning line, as determined by one of the set-reset circuits on Diagram 2. U4481C pin 8 will be low during the center portion of the desired insertion test line. This ultimately generates an ITS key of that same width. Other connections to S9225 ensure that noise is added in this second mode but not in the first where deletion only is required.

Noise Insertion. The third noise measurement mode involves the insertion of noise during the center portion of all lines in the full field interval. This is available only through the PREVIEW channel. In the PREVIEW mode a low, or ground, is applied to pin 13 of U4481D. This means U4481D, which in all other modes operated only during the vertical blanking interval, now operates at all times during the active field.

Indicator Logic

This stage controls the operating mode indicator lamps on the front panel.

Two signal lines, labeled HIGH FOR AUX and LOW FOR PREVIEW control this circuit: When HIGH FOR AUX is high, Q4071 conducts, lighting the BYPASS indicator. When HIGH FOR AUX is low, U4281C is enabled. When LOW FOR PREVIEW goes low, U4281C generates a high on pin 10 and Q4091 will conduct, lighting the PREVIEW indicator. When LOW FOR PREVIEW is high, pin 10 of U4281C will be low, enabling U4281D. Q4081 conducts, lighting the PROGRAM indicator.

Auxiliary Logic

The auxiliary mode of operation requires that the ITS key signal be essentially a composite blanking signal. The ITS switches shown on Diagram 0_b operate in such a fashion that the sync burst and blanking of the 148 are added or mixed with the incoming auxiliary signal. U4381D combines vertical and horizontal blanking in order to produce a composite blanking signal applied to pin 2 of U4381A. Pin 1 of this gate is high when the front panel switch calls for the auxiliary mode. The desired ITS keying signal is therefore developed at pin 3 of U4381A.

DIAGRAM 5 a, b, & c

The Gen-Lock circuitry is used to provide reprocessed composite sync, and lock the internal 4.43 MHz oscillator to the incoming burst signal.

Sync Separator Circuit 5 a

The circuit removes sync from the externally applied composite video signal. Processing of the composite sync eliminates any degradation of the incoming composite sync, such as white noise, 50 Hz hum, etc.

Processing of composite sync is accomplished by clamping the sync tip level of the external composite video to a predetermined level, then adjusting the blanking level by controlling the overall circuit gain.

Fig. 3-3 is a block diagram of the Sync Separator circuit, and the description that follows is organized with respect to the block diagram and Diagram 5_a.

The sync tip of the external video signal (applied to the PROGRAM INPUT connector) is clamped at the sync tip level by the Sync Tip Comparator circuit, consisting of voltage comparator Q5371 and CR5480, operating as a current switch. The comparator is rate-limited and uses the DC-coupled sync to activate it. Once the comparator is switched, any tilt from the field or the line rate sync tips is eliminated. The rate limiting allows the feedback loop (through Q5481 and Q5287) to open at the trailing edge of the sync pulse, and makes the loop unresponsive to impulse noises. It also allows the Level Memory (C5288) to average the white noise on the sync tip during the time the loop is closed. This average determines the sync tip level.

The output from the Level Memory is applied to two filters. The high frequency errors (sync tip tilt) pass through the High Pass Filter, (R5165-C5063) to control the Summing Amplifier (Q5281). The low frequency components are fed back via the Low Pass Filter (Q5171) to drive the AGC Amplifier (Q5161, Q5187, and Q5281). This filtering eliminates most 50 Hz interference.

The 50% Level Comparator (Q5271-CR5276) processes the sync at the 50% amplitude point between the sync tip level and the blanking level, ensuring correct sync width.

The Blanking Level Comparator (Q5261-CR5274) uses the difference in the duty factor between the sync pulse width and blanking width to determine the blanking level. This method allows the entire system to function because timing information is not required to close the AGC loop. The Low Pass Filter (C5182) averages the output of the Blanking Level Comparator; this voltage controls the overall system gain through Q5187.

Sound- In-Syncs Inhibit

This stage consisting of U5921A and B and U5967A, B, and C, is used to prevent sound-in-syncs from interfering with Gen-Lock. This is because the following circuit (Back Porch Generator) depends upon the trailing edge of sync; sound-in-syncs would cause the Back Porch Generator to operate during the sound-in-syncs pulse.

U5921A produces a pulse that has been delayed from the leading edge of sync. The pulse duration is longer than that of sound-in-syncs, but less than that of sync. This pulse ensures that the Back Porch Generator "sees" only the composite sync and not the sound-in-syncs.

Back Porch Gate Generator

The Gate Generator consists of Q5251 and Q5151. It provides gate pulses to the demodulators which correspond to the time of line sync and back porch, or the time of back porch only.

Negative-going composite sync pulses are applied to CR5258 via the sync separator circuit. CR5258 reverse biases on the leading edge of the composite sync and C5257 charges towards −15 V through R5160. The charge path for C5257 is via Q5251 (normally on) and R5160. The trailing edge of the composite sync forward-biases CR5258, which couples a positive pulse through C5257 and turns Q5251 off, producing a series of negative-going pulses at the collector of Q5251. These pulses are coincident with

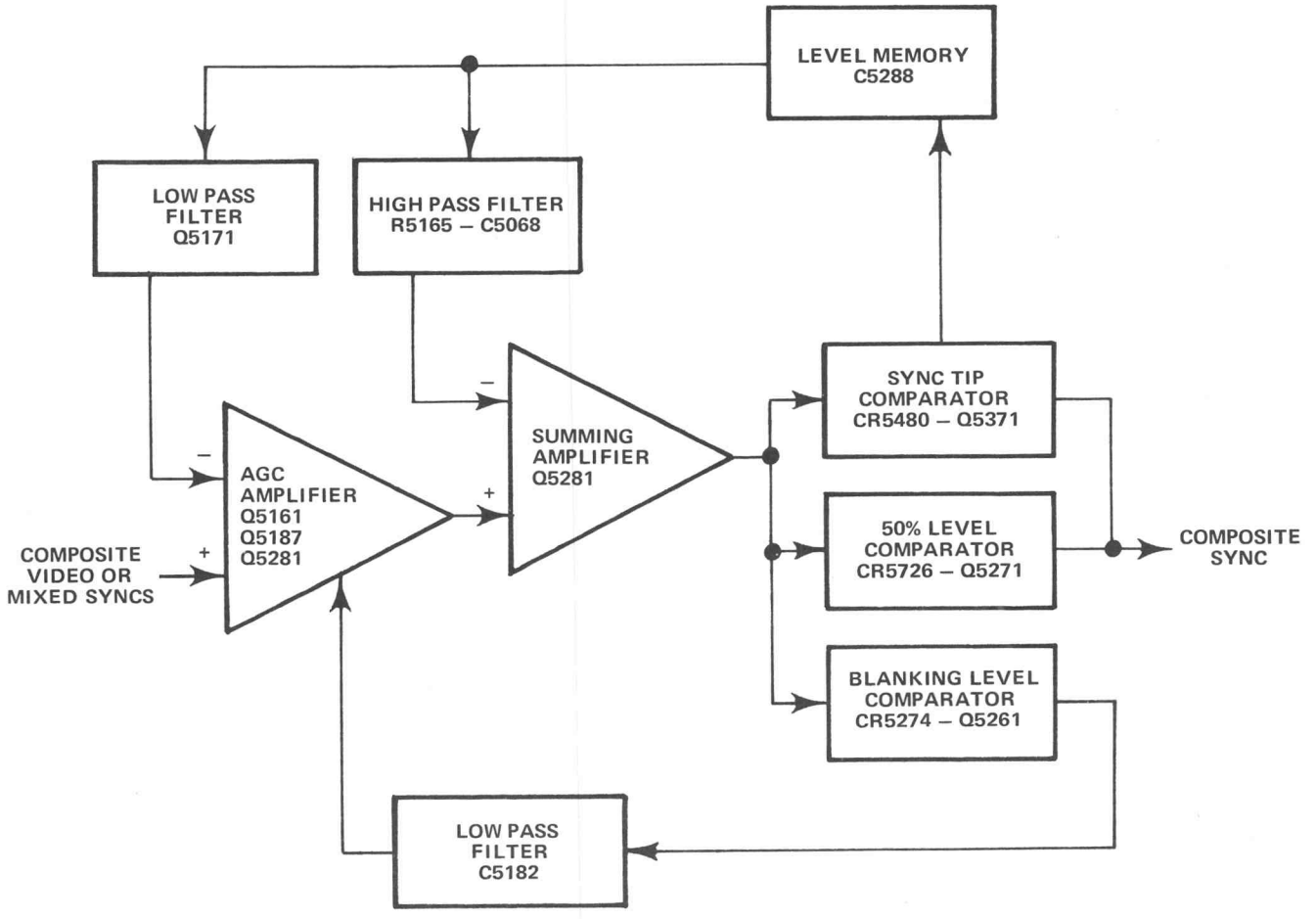


Fig. 3-3. Block diagram of the sync separator circuit.

the trailing edge of the line sync, the equalizing pulses, and the vertical sync pulses.

With P5150 in the BURST position (pins 1 and 2 connected), composite sync pulses via R5259 are added to the delayed pulses from Q5251, to drive Q5151. The duration of each output (positive-going) pulse to the demodulators corresponds to the duration of the input line sync and back porch. With the BURST-CW jumper wire (P5150) in the CW position (pins 2 and 3), the output pulse duration to the demodulators corresponds to the time of back porch only.

Chroma Amplifier

The Chroma Amplifier consists of the Chroma Trap (C5055 and L5056) and three operational amplifiers in series with external AGC control.

Chroma Pickoff. The trap consists of a series resonant LC circuit (C5055 and L5056). The 4.43 MHz components of the signal, applied to the input, are separated from the external sync by the trap and applied to the Chroma Buffer Amplifier.

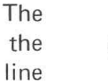
Chroma Buffer Amplifier. Q5051 and Q5041 are connected as an operational amplifier with low input impedance. The output (4.43 MHz subcarrier signal current) is regulated by the AGC circuit and applied to a second operational amplifier, Q5031-Q5021.

AGC OPERATION

The gain control circuit components include Q5141 and CR5040. This circuit regulates the subcarrier signal current (through CR5040 to the input of operational amplifier Q5031-Q5021) by shunting (through CR5040) a portion of the signal current (at the junction of C5041 and C5043) through CR5040 to ground. The amount of current shunted through CR5040 depends on the current demand of Q5141. If the subcarrier signal current is excessive, an increased negative-going corrective signal from the AGC comparator is applied to the base of Q5141. This increases the current through Q5141, which increases the current through CR5040. This decreases the impedance across the diode and shunts more of the signal current away from operational amplifier Q5031-Q5021, thereby decreasing signal input to the amplifier stage.

Limiting Amplifier. Q5031 and Q5021 are connected as a low input impedance operational amplifier with the feedback resistance (R5030) shunted by CR5010, CR5012, and C5034. This provides signal limiting to ensure that the subcarrier (due to peak signals) does not leak through the demodulator during non-demodulation time.

Output Amplifier. The output amplifier (Q5131-Q5231), an operational amplifier, insures adequate drive current for the demodulators. L5100 is adjusted to compensate for subcarrier phase shift errors through the amplifiers.

Quadrature Demodulators 

The Quadrature Demodulator circuits produce output signals which correspond to the amplitude and phase of burst (if any) from the externally applied composite video signal, to control the internal master oscillator.

Demodulator Driver. Q5511, Q5521, Q5421, and Q5431 are connected as differential comparators. Q5511 and Q5421 are turned on and off, at the subcarrier rate, during line sync and back porch time (or back porch only) to provide switching current to the demodulators. Q5521 and Q5431 are driven by the internally generated subcarrier signal, with Q5521 operating 90° later than Q5431. Subcarrier delay is provided by L5610, C5625, and C5620. R5616 terminates the line. Quadrature shift allows burst demodulation in any quadrant (demodulation may take place between 0 and 360 degrees). Q5511 and Q5421 are driven simultaneously by the Back Porch Generator.

Quad Demodulators. The demodulators, Q5331 and Q5411, are forward biased by Q5511 and Q5421 during non-demodulation time. External chrominance from the Chroma AGC Amp is therefore shunted to ground through Q5331 and Q5411. During demodulation time (burst time of the external chrominance signal), Q5331 and Q5411 are switched by the demodulator enable switch at the subcarrier rate. The demodulated chrominance signal is then applied to low-pass filters L5340-C5344 and L5420-C5432. The output of the filters is therefore, a DC level that represents the phase and amplitude of the external burst signal plus the internal subcarrier signal. Under normal operating conditions, the output of Q5331 is an alternating positive and negative DC voltage level during burst time; the output of Q5411 is a negative DC voltage level during burst time. The output of each demodulator filter drives the AC Pulse Amplifiers.

Q5451-Q5457 and Q5441-Q5447 amplify the demodulated chrominance signal level obtained from the filters and drive memory capacitors C5545 and C5458.

Back Porch Clamps. Q5551 and Q5467 hold the inputs to the Quad Phase Burst Rectifiers and Buffer Amplifiers at 0 volts during non-demodulation time. This allows the memory capacitors to charge to a DC level dependent upon the phase and amplitude of the demodulated signal.

During back porch time, a signal applied from the Back Porch Gate Generator turns Q5467 and Q5551 off. This permits the charge on the memory capacitors to drive the Burst Rectifiers and Burst Clamp stages.

Burst Rectifiers. Q5461 and Q5651 are the active components of this stage, and are connected as phase inverters. This allows detection of the demodulated signal in any quadrant.

During back porch time the charge, if any, on memory capacitors C5458 and C5545 drives Q5461 or Q5651 to produce a positive or negative (depending on phase) output. The more negative pulse is then coupled through one of the diodes CR5572, CR5576, CR5660, or CR5651 to drive the PAL Switcher stage.

Burst Clamps

The V Burst Clamp and the U Burst Clamp stages are identical; only the V Burst Clamp will be explained.

Q5561, an emitter follower, passes the signal to two clamp transistors, Q5581 and Q5591. The clamp transistors are driven alternately from the PAL Switcher stage, hence the drive to Q5891, an emitter follower, is clamped in one direction and the drive to Q5591 is clamped in the opposite direction. The drive to Q5991, an emitter follower, is therefore an average of these two clamps.

PAL Switcher

Q5581 provides current, depending upon burst phase, to Q5597 and Q5691, a current switch. It is used to provide alternate switching to the clamp circuits.

PAL Preset

Q5997, an inverting amplifier, is used to control the Bruch Sequence (see discussion of Diagram 8).

Burst Lock Disable. Q5487 is the active component of this stage and is used to turn on the Burst Clamps except during Gen-Lock.

With the 148 operated in the non-Gen Lock mode (no incoming sync), Q5487 is turned on by a signal from the Sync Present Detector (see Diagram 9). This turns the clamp transistors on, clamping the output of the Quad Demodulator stage at all times.

Subcarrier Oscillator and Frequency Control 5c

The Subcarrier Oscillator and Frequency Control circuitry is used to switch the internal 4.43 MHz oscillator from a free run mode to a locked mode or vice-versa.

500 Hz Filter. R5784-C5680 and R5684-C5788 filter the signal pulses from the Quad Demodulators to provide a signal that corresponds to the amplitude and phase of the external burst.

Quad Phase Rectifier. To provide lockup independent of external burst phase errors versus internal subcarrier phase at the moment of Gen-Lock attempt, Q5871-Q5877 and Q5881-Q5887 are connected as paraphase amplifiers. The output of each amplifier is applied to a peak detector.

Peak Detector. The peak detector circuit consists of CR5874, CR5974, CR5984, and CR5985. The most negative DC level from the Quad Phase Rectifier circuit is detected and applied to the DC Buffer Amplifier.

DC Buffer Amplifier. Emitter follower Q5981 acts as a buffer and provides the necessary drive for the AGC Comparator and Burst Present Detector circuits. The output of the buffer is filtered by R5774 and C5866 to ensure an average DC level control voltage to the above circuits. The filter has an approximate bandpass of 5 Hz, which causes noise that appears at this point to be common mode to both sides of comparator Q5781-Q5671.

AGC Comparator. Q5781 and Q5671 are connected as a differential comparator with the base of Q5671 referenced to a fixed DC level. The AGC comparator is biased by the output level of Q5981 so that Q5671 is switched off, thus no AGC current is available to the AGC amplifier. With Gen-Lock the output from the peak detector drives the AGC comparator so that an AGC current corresponding to the amplitude of the externally applied burst signal, is developed through Q5671. This current is fed back to the Chroma AGC Amplifier and increases or decreases the overall chroma gain. Under normal Gen-Lock operation, burst amplitudes of approximately 71 mV to approximately 286 mV switch the comparator and produce an AGC output current.

Burst Present Detector. Q5987 and Q5971 are connected as a Schmitt Trigger circuit. If external burst is present, the output DC level from the buffer (Q5981) steps down and triggers the Schmitt circuit. The differential output of the Schmitt circuit drives the subcarrier reference switch.

Subcarrier Reference Switch. Q5921 and Q5941 form this circuit, which is controlled by the Burst Present Detector. When not Gen-Locked, both transistors are saturated. This provides a resistive divider consisting of R5910, R5920 (4.43 MHz adj.) and R5912 connected between −15 volts and ground (through both transistors). Control of the 148 internal oscillator frequency depends on the setting of R5920. When Q5921 and Q5941 are reverse-biased by the output of the Burst Present Detector, the Subcarrier Reference Switch circuit "floats". Control of the internal master oscillator now depends on the Quad Demodulators output signals that are applied to the Error Amplifier Q5937-Q5951.

Error Amplifier and Band Switch. This circuit controls the 148 oscillator frequency during Gen-Lock mode of operation. Q5937 and Q5951 are connected as an integrating operational amplifier with C5956 as the feedback capacitor. R_i for this amplifier consists of R5762 or R5762 shunted by R5863 and the transistor switch Q5861.

The rate of integration of the operational amplifier is changed by switching, the Band Switch, Q5861 on or off. The input resistance (R_i) is low when Q5861 is switched on. This increases the rate and amount that the amplifier output voltage shifts the internal master oscillator. With Q5861 turned off, the rate is relatively slow (R_i high) and the bandwidth shift of the oscillator is narrow, improving the noise immunity of the amplifier. Control of Q5861 is obtained from the Quad Lock Detector circuit.

Quad Lock Detector. The Quad Lock Detector circuit consists of a lock delay circuit (Q5961) and a Schmitt multivibrator circuit (Q5851-Q5857). The output of the multivibrator controls the Band Switch.

During initial Gen-Lock, Q5961 is forward-biased by a negative pulse applied via CR5952 from the Burst Present Detector circuit. This discharges C5950, which turns Q5857 on. The output of the detector (collector circuit of Q5851) is therefore a negative gate which switches Q5861 on. When lock occurs, Q5961 is turned off by the quadrature signal from the Demodulator circuit, allowing C5950 to charge towards +15 volts. This delays triggering the Schmitt multivibrator to turn Q5861 off, which ensures lock has occurred.

Q5931 is part of the Reed Switch Drive Circuit as described with Diagram 9.

4.43 MHz Oscillator

The 4.43 MHz crystal controlled oscillator generates the subcarrier used by the 148. In the free-running mode, the frequency will be within 25 Hz of 4.43361875 MHz. In the locked mode, the frequency will be locked to the incoming program burst. The output is amplitude limited and applied to the Subcarrier Output Amplifier (see discussion of Diagram 9) for further processing.

DIAGRAM 6a & 6b

The Function Generator generates the sinusoidal burst packets of the multiburst signal. The average level and the black and white reference levels of this test signal are also generated on this circuit board. The sinusoidal output waveform of the function generator is obtained by diode shaping symmetrical triangular wave train.

M. B. Enable

When a multiburst signal is to be generated Q6103 receives a high state signal from the logic control circuitry on Diagram 4. This causes all of the diodes driven by the cathode of CR6017 to become reverse-biased. This now allows any of the transistors in the column headed by Q6106 to conduct, providing the remaining diode in the emitter circuit is also reverse-biased.

Multivibrator Rate Control

This stage sets the rate of charge and discharge current for the integrator within the Triangle Generator circuit.

The emitter circuits of Q6266 and Q6164 are such that, for any given base voltage, Q6164 demands twice the current as Q6266. This base level is set by emitter follower Q6262. Q6106, Q6212, Q6222, Q6228, Q6233, and Q6244 set the current through R6144. Each sets a specific base voltage for Q6266 and Q6164.

Refer to Q6106. When the anode of CR6013 is low, enabling multiburst, and CR6113 receives a low from Diagram 2a R6117 and R6304 set the current through Q6106 and R6144. The resulting voltage drop across R6144 sets the base voltage on Q6262.

Current Switch

This stage provides charging and discharging current for the integrator within the triangle generator. The Current Switch circuit is controlled by the Triangle Level Detector.

Current demanded by Q6266 is provided by U6170B. U6170A and U6170C form a constant current generator providing the same current flow as in U6170B.

Q6162-Q6068 is a current switch providing current for Q6164. When Q6068 is conducting, pin 1 of U6170 drives

the Triangle Generator. When Q6068 is cut off, Q6162 turns on, connecting Q6164 to U6170 pin 1. Because Q6164 requires twice the current available from U6170 A and C, an equal amount of current is drawn from the Triangle Generator.

Triangle Generator

This stage is basically an integrator, providing linear positive and negative ramps. The charging and discharging currents driving the integrator determine the ramp rate.

The triangle generator consists of Q6398 and Q6494-Q6482. The latter transistor is normally held in a clamped or conducting condition when no signal is desired from the triangle generator. When it is desired to generate a triangular signal, CR6376 is reverse-biased and Q6482 is cut off. At this time, the frequency determing current described above is allowed to flow in integrating amplifier Q6398-Q6494. The remaining transistors in this section of the circuit form an emitter follower; the voltage at the emitter of Q6593 is essentially the same as that on the collector of Q6494.

When current flows from the Current Switch to the integrator, the base of Q6398 moves negative. The emitter follows, driving the base of Q6494 down negative. Inversion and amplification take place within Q6494. Negative feedback for a linear positive ramp is provided by C6382.

At +5 V ramp amplitude, the Triangle Level Detector switches the Current Switch. When current is drawn from the integrator, the base of Q6398 moves and a negative ramp is generated. The direction of input current will again be switched at –5 V ramp amplitude.

Ramp rate is determined by the magnitude of input current. As current in both directions is of the same magnitude, the ramp rates (positive and negative) are the same, resulting in symmetrical triangle waveforms of a particular frequency.

Triangle Level Detector

When the output of the Triangle Generator reaches +5 V, the voltage at the base of Q6786 turns it on, switching CR6182 to its low state. This turns off Q6068.

When the output of the Triangle Generator reaches –5 V, the voltage at the base of Q6877 reaches turn on bias, switching CR6182 to its high state. This turns on Q6068.

Stop Control

This stage controls the level at which the Triangle Generator stops; and inhibits the generator during non-multiburst time. To generate a burst packet for the multiburst signal, a positive-going pulse of the necessary width is applied the emitter of Q6198 from the Mod Pulse Timing circuit on Diagram 2. This signal in turn causes a positive-going voltage to appear across R6398, turning Q6298 on and Q6392 off. This allows CR6376 to reverse-bias; at that time the Triangle Generator starts to run. When the pulse at the emitter of Q6198 goes low and Q6198 cuts off, the voltage across R6398 does not immediately go back to its negative condition. It is held up by Q6095. Q6095 is driven from a switching pair, Q6091-Q6192, which is essentially in parallel with the switching pair that controls the current reversal in the Current Switch circuit. Q6095 will only allow the voltage across R6398 to go negative during the positive half cycle. This ensures that the burst packet will end only during the positive-going half cycle. The Stop Level circuit determines the burst packet ending point.

Stop Level

This stage sets the quiescent or 0 level of the Triangle Generator.

The voltage at the base of Q6569 is very nearly equal to the output voltage of the Triangle Generator, that is, the collector of Q6494. As the output rises during the positive-going half cycle, it eventually reaches a point where it is equal to the voltage selected by potentiometer R6673. At that point, Q6482 turns on and the Triangle Generator stops.

Diode Shaper

In this circuit 12 diodes are used to shape the triangular waveform into a sinusoidal waveform. Each diode is biased at a particular voltage and is connected to the necessary series impedance to produce the desired change of slope of the triangular signal to produce a good approximation of a sinusoidal signal.

Amplifier

Q6653B, Q6758, and Q6852 form an operational amplifier that sets the amplitude of the multiburst. Q6653A and Q6858 provide temperature compensation.

R6942 matches the reference level of all Full Field Test Signals to the vertical blanking level.

R6741 (MB GAIN), in series with R6844, controls the gain of the amplifier. It is shunted by a bandpass limiting network. C6740 and R6736 (MB BANDPASS).

Multiburst Pedestal

Three transistors are used to determine the average level and the black and white reference levels of the multiburst signals. Each of these three transistors is held cut off by the high state of the M.B. Enable signal at the anodes of CR6913, CR6918, and CR6923. This signal goes to a low state whenever a multiburst is to be generated. At that time, the other diodes in the emitters of these transistors control the collector current. Q6813 determines the center or average level of the multiburst signal and is adjustable by R6833. The white reference level set by R6835 is switched on by Q6824. The black reference level is adjustable by R6938 and is switched on by Q6828. Both the black and white reference levels are modified to appropriate values by S9250, MULTIBURST AMPLITUDE, to select either a 420 mV or a 700 mV multiburst amplitude. Q6803 sets quiescent current in the amplifier on Diagram 7.

Noise Pedestal

This circuit supplies the current to set the pedestal level of the NOISE test signal. It is controlled by the front-panel NOISE and PEDESTAL switches.

The NOISE pedestal is enabled by a low input to the anode of CR6603, allowing Q6715 to conduct through CR6705. PEDESTAL current is set by S9230 and R9230 in the DELETION mode. R9225 modifies the PEDESTAL current in the INSERTION mode to provide a VARIABLE PEDESTAL.

DIAGRAM 7a & 7b

This board contains the two major output amplifiers for the instrument. One amplifier handles luminance signals; the other handles the chrominance, noise, and the burst packets of the multiburst signal. This board also contains the External ITS Amplifier and a clamp circuit, which ensures that the black level of inserted ITS matches that of the incoming program signal. The sine-squared pulse and bar generators, together with the sine-squared shaping filters, are also included on this board.

Pulse Generator

The T or 2T sine-squared pulse is generated by driving a sine-squared shaping filter with a very narrow pulse. When a 2T or T pulse is desired, a negative-going pulse is inverted in L7110 and applied to the base of Q7001. This turns on Q7001 and discharges C7212 through Q7221. The amplitude of this pulse is determined by the value of the voltage to which C7212 was charged prior to its discharge time. This in turn is determined by either R7138 (T pulse) or R7131 (2T pulse). The resulting pulse of current in the collector of Q7221 is applied to either the T or 2T filters.

Bar Generator

Negative-going bar width pulses allow emitter current to flow in Q7241, which is adjustable by R7143. The resulting current is applied to either the T or 2T filter. Selection of T or 2T risetimes or pulse widths for the bar and pulse is made by placing the jumpers on P7321 as described in the operating instructions.

Modulated Pulse Luminance Amplifier

The modulated sine-squared pulse is composed of the linear addition of a 20T luminance pulse and a 20T envelope chrominance pulse. The luminance portion of this signal is applied to pin 1 of P7193, passes through Q7630A and is delivered to the modulated pulse luminance filter.

Filters

The T and 2T sine-squared shaping filters are used to produce sine-squared transitions from the very fast Pulse or Bar Generator[1]. Several other inputs are also provided to the T and 2T filters. These include all the various pedestal signals associated with multiburst, noise, the LINE 331 signal, and all the various flat field signals. The luminance portion of the staircase and full line linearity signals are also applied to the 2T filters. These various inputs appear on P7101 and pins 3 and 4 of P7001. The modulated pulse luminance filter is used to produce a delay equal in value to the delay of the modulator and its associated band pass filter, so that both the chrominance portion of the modulated sine-squared pulse and the luminance experience the same amount of delay. Thus, the resulting composite pulse exhibits no chrominance-to-luminance delay.

Luminance Amplifier

The luminance amplifier receives signals from the outputs of each of the three filters mentioned above. The amplifier is an operational amplifier whose gain is set by R7735. Its output impedance is low enough to drive three 75 ohm loads. These are the front and rear full field test signal jacks and the termination provided by the External ITS Amplifier.

Chrominance Amplifier

This amplifier is very similar to the Luminance Amplifier, however, associated with its input circuitry are several auxiliary circuits. The chrominance enters this amplifier at pin 2 of P7691 and may be adjusted in amplitude with R7661. The noise signal enters at pin 6 of P7691. The flow of noise is controlled by the two noise gating transistors Q7551 and Q7651. The level of the noise may be adjusted

[1] A Kastelein "A NEW SINE-SQUARED PULSE AND BAR-SHAPING NETWORK" IEEE Transactions of Broadcasting, Volume BC-16, Number 4, DEC. 1970 (pp 84-89).

with R7561. Multiburst enters at pin 1 of P7491. Signal current flows at all times through R7551 and R7553. This is sufficient to produce the 420 mV multiburst amplitude. When the full multiburst amplitude is desired, Q7481 is cut off by the multiburst amplitude switch on the front panel and multiburst signal current then flows through two parallel paths: R7551-R7553 and R7461-R7581. Both Q7481 and Q7571 are gated to inhibit the passage of the multiburst signal during the 7-1/2 Line Keyout pulse.

Ext ITS Amplifier

An external insertion test signal may be inserted on the program output of the 148. Such a test signal is applied to J9011 on the rear panel. This signal is amplified by Q7981, Q7971, and Q7961. The output of this amplifier is connected to the insertion test signal input of both the preview and program insertion test signal switches.

ITS Amp Clamp

Since the incoming program signal is clamped to ground, as described in Diagram 0, the internal insertion test signals are also clamped to ground that, when they are inserted, the two black or ground levels match.

A sampling pulse is supplied to pin 1 of P7003 during the back porch portion of the internally generated test signals. Q7191 is turned on by this clamp pulse and the resulting sampled level is transferred to memory capacitor C7383. This voltage is amplified by the high gain operational amplifier U7291. This amplifier error signal is further amplified in the Ext ITS Amplifier and applied once again to the same point as originally sampled. This restores the back porch level of the Insertion Test Signals to ground.

DIAGRAM 8

The circuitry on Diagram 8 is used to shape and phase signals to drive the modulator. Exceptions: Q8911 and CR8910, a current switch, is used to set the amplitude of the regenerated composite sync for use with the full-field test signals; Q8461 is used to disable the modulator during noise measurements; and Q8071-CR8082, a current switch, sets the luminance amplitude of the LINE 331 SIGNAL.

Bruch Burst Blanking

U8620, U8720, and U8820 provide the Bruch Sequence key-out pulses so that burst current is not available as follows: Field 4, lines 319 and 623; Field 2, lines 6 and 310, and Field 2, lines 362 and 363.

NOTE

Bruch Sequence is an arrangement of colour burst signals which assures that the starting polarity of the burst signal is the same at the start of each field, for improved stability of colour synchronization.

LINE 331 and LINE 330 Chroma

These two stages consist of 5 current switches, which are used to set the amplitude of the chroma on the LINE 330 and LINE 331 signals for use in the modulator, and the current source for the LINE 331 Pedestal.

Each transistor is a current source whose current is set by the emitter resistance. The transistor conducts when both disconnect diodes in the emitter circuit receive low enabling signals. When either diode is high it shunts current away from the transistor.

Bandpass Filter

This stage consists of a pair of series resonant tanks tuned to 4.43361875 MHz. The placement of these tanks (one in each output lead) ensures symmetrical output; the component values limit sideband output.

Modulator

The modulator consists of doubly-balanced modulator U8890. The modulator has two pairs of imput terminals, one for the subcarrier or switching signal (pins 7 and 8 of U8890) and the other pair for the modulating signal (pins 1 and 4). Two balance adjustments, R8990 and C8997, ensure that there is no subcarrier output when there is no signal input at the modulating terminals of the modulator.

Subcarrier Amplifier

This stage amplifies and limits the subcarrier signal to the switching terminals of the modulator. At this point, the subcarrier input to the modulator can be disabled during noise measurements where small amounts of subcarrier feedthrough could obscure the measurement of small noise signals. This disabling input is P8200-3.

Subcarrier Phase Control

For standard test signal, three discrete phases of subcarrier are needed. These are 135° and 225° for the phase alternating burst, and 60° for all test signals. A CW subcarrier signal is supplied to P8100-1. This signal is steered through one of three phase shift networks, depending upon which test signal component is desired. The two burst phases are determined by the phase shift networks in the emitters of Q8150 and Q8158. Each of

these transistors is turned on during alternate horizontal blanking intervals by the four-diode and gate, which is supplied with horizontal blanking by way of P8100-3 and a pair of line alternation pulses from the Bruch Burst Blanking Circuit. The 60° test signal phase is determined by the phase shifter in the emitter of Q8166. The subcarrier signal is steered through this transistor during the active line time. An optional fourth phase shift channel, with the ability to set phase at any point in the four quadrants, is also supplied for determining the phase of only the modulated 20T sine-squared pulse. As shipped from the factory, P8100-3 is normally grounded, however, if an adjustable phase for the modulated 20T pulse is desired, this terminal is connected to P4930-6. The procedure for exercising this option and for setting the phase is described in the operating section of this manual. When this option is used, it is necessary to switch between the 60° phase shift, which is required for all other chrominance information in the test signals, and the output of the variable or adjustable phase shifter. The switching logic is contained in U8110. The adjustable phase signal passes through Q8148. The outputs from each of these four phase shift channels are combined at the emitter of Q8261. In the collector of this transistor is a parallel resonant circuit containing a voltage-variable capacitor. The DC voltage applied to this element is governed by the INSERT SUBCARRIER PHASE control on the front panel and is required to trim the test signal phase to be properly referenced to the incoming program signal. Q8371 is a limiter amplifier.

Modulator Drive

This stage provides the current required for modulation of the 4.43 MHz carrier for burst, modulated sine-squared pulse, staircase, LINE 330, and LINE 331 test signals.

The burst envelope filter consists of L8730 and associated capacitors. Current is steered through Q8641 to make a burst at such times as two conditions are present. One is the burst flag itself and the other is an enabling signal from the Bruch Burst Blanking Circuit. Burst amplitude is set by R8431. Current to produce the chrominance portion of all other test signals flows through the slower filter consisting of L8390, L8290 and associated capacitors. The modulated 20T pulse appears at P8960-2. A DC-balancing signal derived from the 20T sine-squared generation circuit appears at P8960-4. These last two signals are applied to the push-pull input of the modulator drive circuit, which is the base of Q8851A and B. The 20T chroma level is set by R8870.

DIAGRAM 9a & 9b

The circuitry contained on the Subcarrier and Sync board is used to provide current for the burst and composite sync amplifiers for use at the CW SUBCARRIER OUTPUT and COMP SYNC OUTPUT. In addition, sync lock detection, generation of the modulated sine-squared pulse, and the FULL FIELD SIG mode sequence are included.

Comp Sync Amplifier

CR8 and Q21 form a current switch. When CR8 is reversed biased, current through R7 is diverted through Q21, which drives the filter (L20, L120, C32, C28, and C46). The filter limits the risetime of the composite sync signal.

Q71, Q141, and Q151 are the active components of an operational amplifier. R42 is the feedback resistance; the input current is determined by R7. Q61 provides current for reverse-terminating any negative pulse which may appear at the output terminal due to unterminated coaxial cables.

Q381 provides drive to the ITS switch control (see Diagram 0 $_b$) so that, in the event of PROGRAM INPUT interruption, internally generated Full Field signals will be switched to the PROGRAM LINE OUTPUT.

Subcarrier Amplifier

Q81 is an emitter follower that serves as a buffer and driver. It isolates the oscillator (see Diagram 5 $_c$) from the output. Because Q81 is biased near cutoff, it clips the negative portion of the input signal so that the drive signal to Q91 pulses the collector tank circuit (L190, C196, C194, and C198).

The output drives an operational amplifier consisting of Q181 and Q271. This circuit serves as a distribution amplifier to drive the various circuits within the 148, plus the CW SUBCARRIER OUT connector.

A relay, K370, opens the CW Subcarrier output line in the event burst is lost from the driving source. (See Operating Instructions for exception.)

Vert Sync, Horiz Sync, and Regen Sync Timing

These three sections of Diagram 9 are best treated as one. Regenerated sync should be contrasted with separated sync. The latter is stripped from the incoming program signal and therefore contains the identical timing information of that signal, including any jitter if present. The timing for regenerated sync is derived from the internal timing circuits of the 148, and is present even in the absence of an incoming signal.

The train of pulses that form the regenerated sync signal are formed in monostable multivibrator U301. There are

basically two inputs to this multivibrator: One is a trigger or timing input, which determines the leading edge time location of each of its output pulses (Horiz Sync). The other input determines the width of the pulse (Vert Sync).

The standard composite sync signal requires that the trigger pulses appear at a line repetition rate during most of the active field, including most of the vertical blanking interval. However, during the 7-1/2 line interval that includes the equalizing pulses and the vertical sync pulse, the timing information rate must be doubled to twice line rate. Similarly, the width of the regenerated sync pulses must be of line sync width during the active portion of the field, including most of the vertical blanking interval but must be appropriately narrowed for the equalizer pulses and widened to produce the serrated vertical pulse.

The pulse width of the monostable multivibrator U301 is determined by three current paths into the pulse width timing capacitor, C335-C337. R356 and R336 provide current at all times and represent the minimum amount required for the production of the serrated vertical pulses. A second path, controlled by Q321, supplies additional current when normal line rate sync pulses are required. This transistor is driven by a 7-1/2 Line Keyout pulse, which stops flow of current during the 7-1/2 line interval around the vertical sync pulse.

The third current path is supplied with a complex signal that steers the largest amount of current into the monostable multivibrator during the first and last 2-1/2 lines of the vertical sync interval. During the middle 2-1/2 lines of this interval, the current is interrupted, leaving only the steady minimum value to produce the serrated pulses.

The logic to produce that control signal comes from the Vert Sync circuit. Two characteristic instant pulses drive U321A, producing a twice-line rate timing signal. This timing signal is applied to the trigger input of counter U201. This counter is connected to count by 5, producing an output after the fifth timing pulse at its input. The output pulse lasts for a period of five more twice-line rate pulses, and is combined by U101C with the 7-1/2 Line Keyout pulse to produce first a high, then a low, then a high state corresponding to each third of the 7-1/2 line interval. This output occurs only once per field (since the 7-1/2 line signal itself is used to reset the counter during active field time), and is inverted and applied to the base of Q331 to control the necessary current to produce equalizer and serrated pulses.

The timing pulses to trigger the monostable multivibrator are formed in the section of the diagram headed Horiz Sync. Again, the 7-1/2 Line Keyout pulse is required, since the timing during this interval is twice-line rate and, outside this interval, at the line rate. U321D acts as an or gate receiving a characteristic instant on pin 13, which produces line rate triggers. During the 7-1/2 Line Keyout interval, U321C permits the passage of a second characteristic instant into pin 12 of U321D. The output on pin 11 then contains twice-line rate triggers during the 7-1/2 line interval. Timing control and width control has therefore produced a standard train of composite sync pulses at the output of the monostable multivibrator on pin 8 of U321.

Burst Key

This circuit forms the burst flag pulse. The trailing edge of the horizontal sync pulse drives the base of Q421 negative to −5 V, cutting off Q421. Q421 remains cut off for approximately 750 ns while C415 charges back to 0.6 V. When Q421 turns on, a negative 5 V pulse is passed by Q406 to the base of Q428. Q428 cuts off for approximately 2.2 μs while C407 charges back to +0.6 V. The resulting positive pulse is inverted by Q408 and becomes a low enable to Diagram 8, delayed 750 ns from horizontal sync. In the event burst is lost from the driving source, R408 receives a low inhibit from Diagram 5 $_C$ and no burst key is generated.

Non Sync Inhibit

This stage compares incoming Stripped Sync with Regenerated Sync and inhibits the Line Counter and ITS Key circuits (see Diagram 4) if they are not in step.

The output of U101B is high when both inputs are low, and low when either input is high. Because Stripped Sync on pin 5 and Regenerated Sync on pin 6 are of opposite polarity, one input will be high at all times when they are in step. The resulting low output cuts off Q351. C374 charges positive, turning on Q391 which turns off Q394.

Should incoming sync and Regenerated Sync be out of step (or one not present), U101B senses coincident low states on pins 5 and 6. The resulting output turns Q351 on, discharging C374. Since charge time for C374 through R362 is considerably longer than discharge time through Q351, the bias to Q391 is held below conduction. The collector of Q391 is high, turning on Q394, generating a LOW FOR NON SYNC signal.

Due to the impedances of these charge and discharge paths, a full field is required to charge C374, and about 12 unsynchronized lines to discharge C374.

SIN^2 Pulse Generator

This stage is used to generate the luminance portion of the modulated sine-squared pulse.

Q498 is turned on by a positive pulse from Diagram 2 $_b$. The collector of Q498 goes negative, discharging C487 through Q466 into a 9-pole Kastelein filter. This pulse of current is shaped into the luminance pulse and is sent to the circuits shown on Diagrams 7 $_b$ and 8.

Flat Field Logic

A high FLAT FIELD ENABLE is generated at U470B pin 8 when pins 9 and 10, and pins 1 or 13 are low. Two high inputs on pins 1 and 2 are required for a low output on pin 3 of U450A. The operation of U470A is the same as U470B. Q449 acts as an inverter to drive U470A pin 2 and provides an output that is complementary to that of U359A.

Alternate Switching Logic

This circuit provides complementary ALT switching signals to the Full Field Logic circuit on Diagram 4.

The output on pin 3 of U359A is low each time pin 8 of divide-by-2 counter U339B is high and pin 1 of U359A is high. Pin 1 of U359A is grounded by S9280 only in the ALL LINES position of the front panel switch.

FULL FIELD ENABLE is high on pin 8 of U359C when either input is low. Pin 9 is driven by U359B for ALL LINES and ALT modes. When U359B pin 4 is high and the MODIFIED VERT BLANKING on pin 5 is high, the output pin 6 is low. Pin 10 of U359C is driven by U359D for ALT & 6 LINES FLATFIELD. U339B is clocked 2 μs after the start of each line and divides by 2 so that pin 9 of U339C is high for one line and low for the next. U430A divides by 2 again, providing an output with alternating polarity every two lines. U430B then divides by two, resulting in an output alternating in polarity every four lines. U359D combines the outputs of U430A and U430B so that the output on pin 11 is low for two lines then high for six. All three counters are reset by MODIFIED VERT BLANKING and held off for the vertical blanking interval. U450B enables U470B for the 6 lines of flat field.

LOW FOR WINDOW appears at pin 1 of P461 when CR456, CR454, and CR452 are all low. U450D inverts FULL FIELD ENABLE.

VERT BLANKING is modified to start and end coincident with the end of a line in all fields by U339A. Pin 5 steps low with pin 1, but does not step high with pin 2 until pin 3 is triggered by the characteristic instant pulse for TIME 31 from Diagram 2 $_a$.

MOD PULSE ENABLE

This is part of the circuitry for MOD PULSE ENABLE on Diagram 2 $_b$. U450C pin 8 is low when pins 9 and 10 are high.

DIAGRAM 10

This circuit provides a source identification code for line 16 or 329.

Field and line information from the ITS Line and Field Matrix on Diagram 4 drive U9650C. When U9650C senses low inputs at pins 8 and 9, pin 10 is high. U9650B inverts this to a low enable to the ITS Key circuit on Diagram 4 and to U9650D.

The 25 diodes, CR9610 through CR9649 form a 25-input, non-inverting, low-input or gate. The desired identification code is built by providing inputs to this gate from the Instant Decoder on Diagram 2 $_a$. Each low output from the diode gate switches current from CR9635 and U9650D pin 12 goes low.

The code signal on pin 12 of U9650D appears during every horizontal line. During the line selected, pin 11 of U9650D is driven low and the code appears on pin 13 as positive-going pulses.

CR9658 and Q9659 form a current switch controlled by U9650A. The output of this inverter steps low with each pulse, turning off CR9658. Each time CR9658 cuts off, Q9659 conducts, providing a pulse of current to the pulse generator circuit on Diagram 7. Because the characteristic instant pulses used by the diode gate are 1 μs pulses, the output of Q6959 is 1 μs pulses.

External Drive Receiver

This stage is used to combine externally applied Composite Sync, CW Subcarrier, PAL Pulse, and Burst Flag so that the 148 will Gen-Lock without a PROGRAM INPUT signal.

4.43 MHz. External CW Subcarrier is applied to amplifiers Q9716 and Q9714 90° out of phase, as set by C9719 (225° Phase) and L9710 (135° Phase). This provides subcarrier at 135° and 225°.

PAL Pulse. Q9735 and Q9745, driven by an external PAL Pulse, clamps the output of the 4.43 MHz 135° and 225° subcarrier at 0 volts except during burst time every

other 64 μs (i.e., burst is at 135° on one line, then 225° on the next).

Burst Flag. Q9778 and Q9776, driven by external Burst Flag, clamps the 135° burst and 225° burst at 0 volts except during the time of burst.

Comp Sync. Composite sync is summed (at the junction of C9799 and R9796) with burst to provide the signal required for 148 Gen-Lock.

DIAGRAM 11

The Low Voltage Power Supply circuit provides three regulated supplies; +15 volts, +5 volts, and −15 volts. Electronic regulation is used to provide stable, low ripple output voltages. All the supplies are current-limited to prevent instrument damage in the event that a supply is shorted to ground. The primary circuit of the transformer employs voltage and range selector plugs to permit selection of the appropriate line voltage operating range.

Power Input

Power is applied to the primary winding of transformer T9001 via RFI Filter FL9201, the POWER switch S9201, 115-volt line fuse F9201, Voltage Selector S9203, and the Range Selector S9202. The voltage selector plug connects the split primaries of T9001 in parallel for the 115-volt range of operation, or in series for 230-volt operation. A second fuse, F9202, is placed in the 230-volt position to provide the correct protection for 230-volt operation.

The Range Selector plug allows the instrument to regulate properly on higher or lower than normal line voltages. Each half of the primary has taps above and below the 115-volt (230) point. As the selector is moved from LO, M, HI, more turns are added to the primary winding. Therefore, whether the primary voltage has increased or decreased, the secondary voltage can be maintained at a nearly constant level.

The RFI Filter serves to prevent external RF interference from appearing across T9001 and also prevents signals generated within the 148 from being introduced into the AC line.

−15 V Supply

The −15 volt supply provides the reference voltage for the +5 and +15 volt supplies. The reference for the −15 volt supply is a 9.1 volt zener diode, VR9850.

The output from the secondary winding (pins 6 and 7 of P9850) is rectified by a full-wave rectifier consisting of CR9870, CR9876, CR9874, and CR9872. The rectified voltage is filtered by C9061 and applied through a −15 volt series regulator stage, Q9085, to the load. Series regulator Q9085 and its driver, Q9850, are controlled by a voltage comparator consisting of Q9856 and Q9854 with associated components. C9852 filters any noise generated by −15 volt reference VR9850.

Q9852 and associated components, is an overload protection circuit. During excessive load current, Q9852 (normally off) turns on, which turns Q9850 and Q9085 off, hence the −15 volt supply is disconnected.

+5 and +15 Volt Supplies

Both supplies are similar to the −15 volt supply.

SECTION 4
MAINTENANCE AND CALIBRATION

This section of the manual contains information for use in maintenance and calibration of the 148 as follows:

Maintenance

Preventive Maintenance: Cleaning, lubrication, visual inspection, etc.

Troubleshooting: Aids for isolating trouble to a particular stage, etc.

Corrective Maintenance: Replacement procedures and parts ordering information.

Calibration

Inspection: A list of specifications to be checked when performing an incoming inspection.

Procedure: Step-by-step instructions for returning the 148 to specification.

MAINTENANCE

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, and lubrication. Preventive maintenance performed on a regular basis may prevent instrument breakdown, and will improve the reliability of this instrument.

Cleaning

General. The 148 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket that prevents efficient heat dissipation. It also provides an electrical conduction path.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dirt accumulated on the outside of the 148 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a solution of water and mild detergent. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Lubrication

The reliability of switches and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (e.g., TEKTRONIX Part No. 006-0172-00) for switch contacts. This lubricant does not affect the electrical characteristics of the switch. To lubricate the switch detent, use a heavier lubricant (e.g., TEKTRONIX Part No. 006-0219-00). Do not overlubricate.

Visual Inspection

The 148 should be inspected occasionally for such defects as broken connections, loose or disconnected pin connectors, improperly seated solid-state devices, damaged circuit boards and heat-damaged components.

The correct procedure for most defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Transistor and Integrated Circuit Checks

Periodic checks of the transistors and integrated circuits (IC's) used in the 148 are not recommended. The best indication of performance is the actual operation of the component in the circuit. Performance of the circuit is thoroughly checked when performing either the performance check or calibration procedure. Any substandard transistors or integrated circuits will usually be detected at that time.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the 148. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles.

Troubleshooting Aids

Diagrams. Circuit diagrams are provided on foldout pages at the rear of this manual. Each component, its electrical value and circuit number are shown on the diagrams. In addition, typical voltages which can be expected are also shown.

Each diagram has been assigned a diagram number and name. For example, the first diagram has been assigned the number 0_a and is called PROGRAM LINE AMPLIFIER. (Other circuitry exists on this diagram but, since the program line amplifier is of prime importance, it was so called.) Notice the solid blue line that surrounds most of the circuitry on this diagram. This line is used to identify a particular circuit board on which the components are physically located. This reference allows for correlation between the diagrams, circuit boards, and electrical parts list. All other components on the circuit board will be found on diagram 0_b.

Table 4-1 lists the various reference diagrams, circuit boards, and electrical numbers used in the 148. All components located outside the blue line are chassis mounted components and have circuit numbers from 9000 to 9499.

Circuit Boards. Fig. 4-1 shows the location of each circuit board within the instrument. Each circuit board is shown (full view) opposite the appropriate diagram in the diagram section. Each electrical component on the board is identified by its circuit number. In most cases, these circuit numbers were assigned on a grid system as a convenience to the user of the instrument. For example, notice the circuit board photo opposite diagram 0_a. The upper left hand corner of this board has been assigned numbers around 500.

TABLE 4-1

Diagram	Function or Circuit Board Name	Circuit Numbers
9_a & b	Subc & Sync Out	0-499
0_a & b	ITS Insertion	500-999
1	Vert Counter	1000-1999
2_a & b	Horiz Timing	2000-2999
3_a & b	APL Staircase Noise	3000-3999
4	ITS & FF	4000-4999
5_a, b, & c	Gen-Lock	5000-5999
6_a & b	Function Gen	6000-6999
7_a & b	Output Amplifier	7000-7999
8	Modulator	8000-8999
12	Switching & Chassis	9000-9499
10	ID Code & Ext Drive	9500-9799
11	Power Supply	9800-9999

Proceeding left to right, the numbers go towards 900 at the upper right hand corner. From top to bottom, the numbers increase to 590 at the bottom left corner and 991 at the bottom right corner. Using this method, the physical location of each component is readily available.

Waveforms. Important waveforms (typical) are given opposite the appropriate diagram in the diagram section. These waveforms aid in determining if a circuit is functioning properly.

Wire Colour Codes. All insulated wires in the 148 are colour coded to facilitate circuit tracing. Table 4-2 summarizes the coding system used in the 148.

TABLE 4-2

Colour Code	Significance
Black	Chassis Ground
White on Black	Floating Ground
Yellow on Green	Safety Ground
Brown[1]	Filament and Heaters
Gray[1]	AC Line
White[1]	Signal
Red[2]	B+
Violet[2]	B−

[1] **Colour Stripes are used on these wires as an aid to circuit tracing.**

[2] **Colour Stripe on wire indicates position of supply with respect to 0 volts (e.g., a black stripe on a red wire would be the first voltage in the positive direction). If a second stripe is used (white only), this indicates a non-regulated supply.**

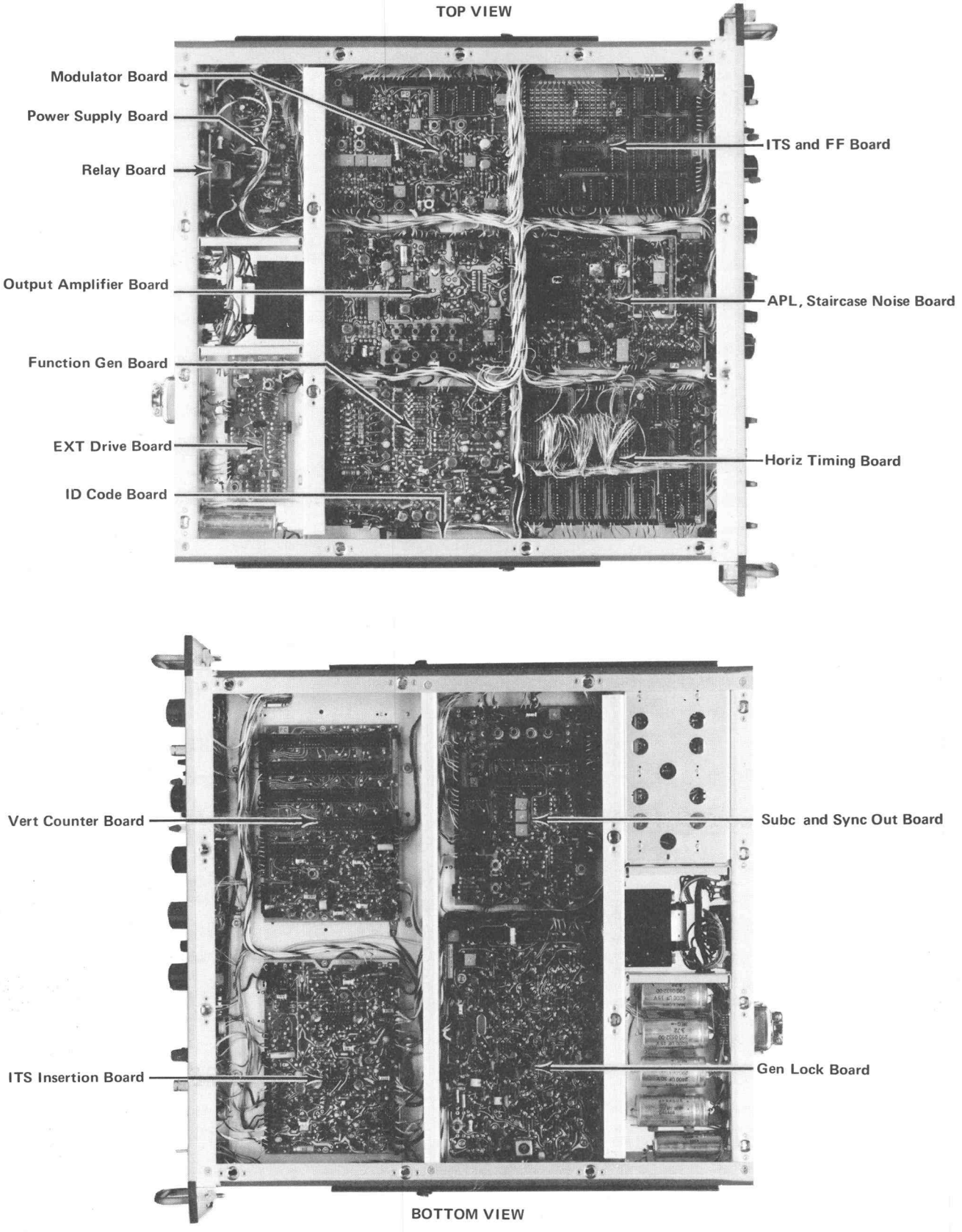


Fig. 4-1. Location of circuit boards in the 148.

Resistor Colour Code. In addition to the brown composition resistors, metal film resistors (identified by their gray or light blue colour) are used in the 148. The resistance values of composition and metal film resistors are colour-coded on the components with the standard EIA colour code.

Capacitor Markings. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the 148 are colour-coded in picofarads using a modified EIA code. The new "tear drop" capacitors are colour-coded in microfarads using a modified EIA code, with the dot indicating both temperature and the positive (+) side.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple possibilities before proceeding with extensive troubleshooting.

1. Check Control Settings. Incorrect control settings may indicate trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions.

2. Check Operation of Associated Equipment. Many times malfunction of equipment can be traced to associated equipment.

3. Visual Check. Visually inspect the portion of the instrument in which the trouble is located. Look for unsoldered connections, loose pin connectors, broken wires, damaged circuit boards, damaged components, etc.

4. Check Circuit or Instrument Calibration. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in this section.

5. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptoms. The symptoms often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. A defective component elsewhere in the circuit can also appear as a power supply trouble, and affect the operation of other circuits.

The Circuit Description section of this manual can be used as a guide for isolating a trouble. This description explains how the various signal components are combined to form the video signal. By using the front-panel controls and checking the signals at the BNC connectors, it is possible to determine circuits that are functioning properly and those that are not.

When a trouble is isolated to the smallest possible area, proceed with steps 6 through 8 in this troubleshooting procedure to locate the defective component(s).

6. Check Circuit Board Interconnections. After the trouble has been isolated to a particular area or circuit, check the pin connectors on the circuit board for correct connection.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated by disconnecting the power distribution pin connectors for the voltage at the Power Supply board when making resistance to ground checks.

7. Check Voltage and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given in the Diagrams section.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the back side of the Diagrams Title page.

CAUTION

Due to the component density on the circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients which may destroy many components.

WARNING

"Ground lugs" are not always at ground potential. Check the diagrams before using such connections as a ground for the voltmeter test prod or oscilloscope probe. Some transistor cases may be elevated.

8. Check Individual Components. The following procedures describe methods of checking components in the 148. Components which are soldered in place should be checked without removal, by isolating the component if circuit conditions allow. If component isolation is questionable unsolder one end.

a. Transistors (excluding FETS, Field Effect Transistors). The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new transistor. However, be sure that circuit conditions are not such that a replacement might also be damaged. If substitute transistors are not available, use a dynamic tester such as the TEKTRONIX Type 576.

b. Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals.

CAUTION

Do not use an ohmmeter range that has a high internal current. High current may damage the diodes.

9. Repair and Readjust the Circuit. If any defective component or part is located, follow the replacement procedure given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in this instrument are described here.

Obtaining Replacement Parts

All electrical and mechanical replacement parts for the 148 can be obtained through your local TEKTRONIX Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance, and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies.

Multiple Terminal Connector Holders. Most inter-circuit connections between the circuit boards, or between the boards and chassis mounted components, are made through pin connectors. The terminals in the connector holder are identified with numbers. Connector orientation to the circuit board is keyed with triangles, one on the holder and one on the circuit board. See Fig. 4-2.

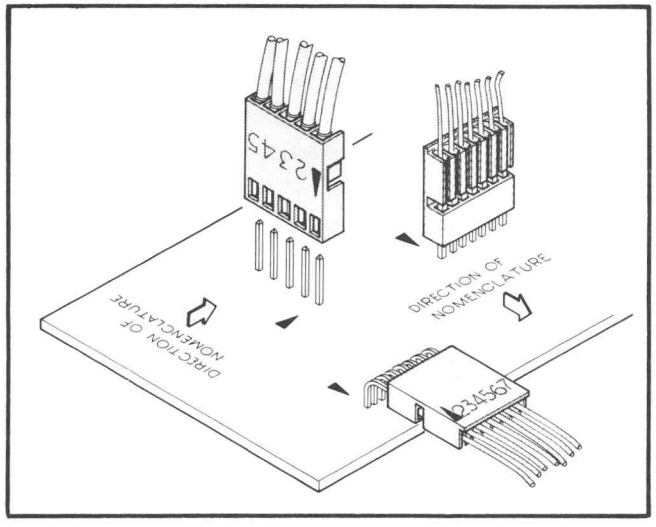


Fig. 4-2. Multipin circuit board connectors.

Circuit Boards. If the circuit board is damaged beyond repair, the entire assembly including all soldered-on components can be replaced.

Transistor and Integrated Circuit Replacement. Transistors and integrated circuits, (IC's) should not be replaced unless they are actually defective. Replacement or exchange of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as on the component being replaced. See Fig. 4-3 for basing diagrams.

The chassis-mounted power supply transistors and their mounting bolts are insulated from the chassis. In addition, silicone grease is used to increase heat transfer capabilities.

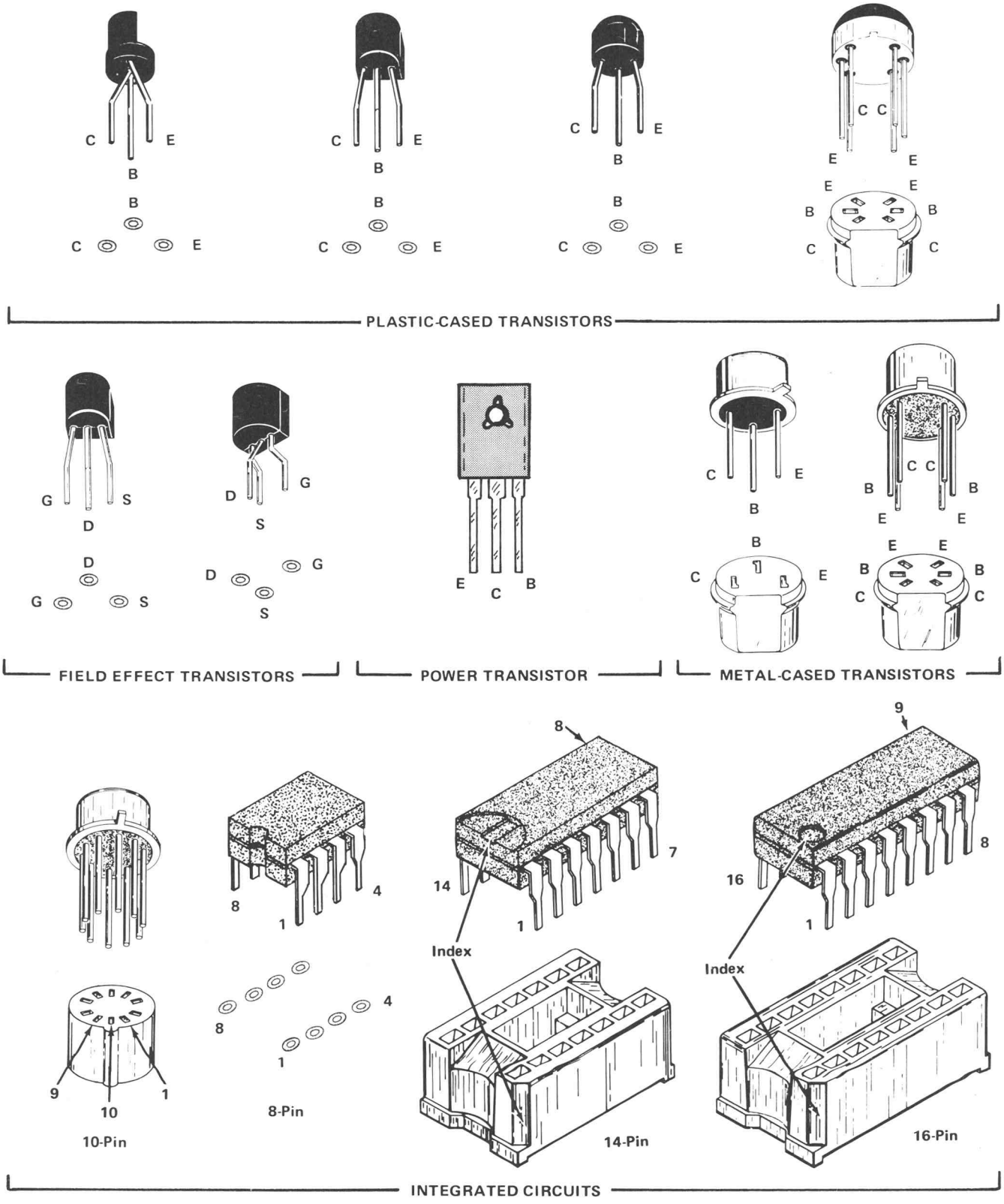


Fig. 4-3. Transistor and Integrated Circuit basing diagrams.

Re-install the insulators and replace the silicone grease when replacing these transistors. The grease should be applied to both sides of the mica insulators, and should be applied to the bottom side of the transistor where it comes in contact with the insulator.

WARNING

Voltages are present on the exterior surface of the chassis-mounted power supply transistors if the power is applied to the instrument and the POWER switch is on.

After any component is replaced, check the operation and calibration of the associated circuits.

Indicator Lamp Replacement. To remove the POWER ON indicator lamp, remove the top dust cover from the instrument, then reach behind the front-panel and unplug the lamp from its socket. To replace the lamp, reverse the procedure.

The NOT LOCKED TO PROGRAM, PROGRAM, PREVIEW, and BYPASS indicators consist of two parts; a lens that is attached to the instrument, and a lens cap (connected to the back of the lens) into which the lamps have been soldered. To remove the lamps, reach behind the front-panel, grasp the lens cap and pull straight away from the front-panel. The lens cap will unsnap from the lens, allowing lamp access. Unsolder the lamp. To replace, solder the new lamp into the lens cap. Then place the lens cap on the back of the lens and apply enough pressure to snap the cap into place over the lens.

Fuse Replacement. Both line fuses are contained in plastic holders in the cover for the Line Voltage Selector Assembly at the rear of the instrument. Use only the correct value replacement fuse. Only the upper fuse within the assembly (3/4 A) is used for 115-volt operation. However, for 230-volt operation both the upper and lower fuse (1/2 A) must be installed.

Switches. If a switch is defective, replace the entire assembly. Replacement switches can be ordered by referring to the Parts List for the applicable part numbers.

Power Input Connector and RFI Filter Replacement. The Power Input Connector and RFI Filter is replaceable as a unit and repair should not be attempted. If replacement is necessary, observe proper polarity to assure instrument protection.

Power Transformer Replacement. If the power transformer becomes defective, contact your local TEKTRONIX Field Office or representative for replacement. Replace only with a direct replacement TEKTRONIX transformer.

The narrow blade (terminal number 4) should show continuity to terminal number 3, which connects to fuse F9201, see diagram 11. (The filter contains an internal non-replaceable fuse between these two terminals.) Use care when soldering to terminals numbers 1 and 3, as excess solder could possibly short the filter case.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

CALIBRATION

This portion of the manual contains the adjustment sequence for calibrating the 148 to the performance requirements listed in the Specification Section. Limits, tolerances, and waveforms in this procedure are given as calibration guides and are not instrument specifications, unless given in the Specification Section.

The Inspection Procedure is provided so that those familiar with the long-form calibration can check instrument specification without following the step-by-step procedure. Those unfamiliar with the 148 should follow the complete calibration procedure, omitting all adjustments, to check instrument performance.

INSPECTION PROCEDURE

			Group	Step
1. CW SUBCARRIER OUT				
Output	2 V	1.6 to 2.4 V	1	5
2. COMPOSITE SYNC OUT				
a. Aberrations		4 cm display ≤ 4% (1.6 mm)	1	6
b. Amplitude	4 V	3.6 to 4.4 V	1	6

			Group	Step
3. FULL FIELD SIGNAL LUMINANCE				
a. FLAT FIELD, 100% APL		702.8 mV (695.9 to 710.0)	2	1
sync		–301.0 mV (–298.00 mV to –304.0)	2	2
output level		0 V ±50 mV	2	3
FLAT FIELD (front)		702.8 mV (695.9 to 710.0)	2	4a
FIELD SQ WAVE		702.8 mV (695.9 to 7.0.0)	2	4b
NOISE PEDESTAL		702.8 mV (689.0 to 717.2)	2	4c
LINEARITY–RAMP		702.8 mV (695.9 to 710.0)	7	1a
10–STEP		702.8 mV	7	1a
5–STEP		702.8 mV	7	1a
LINE 17-bar & 5 step		702.8 mV	7	1a
LINE 330 bar		702.8 mV	7	1a
MB-ped & 500 kHz		702.8 mV	7	1a
WINDOW-bar		702.8 mV	7	1a
b. FLAT FIELD, VAR APL	90%	633.1 mV (629.9 to 636.2)	2	4d
	80%	562.8 mV (560.6 to 565.5)	2	4d
	70%	492.1 mV (489.7 to 494.5)	2	4d
	60%	421.9 mV (419.8 to 424.0)	2	4d
(2)	50%	351.6 mV (349.8 to 353.3)	2	4d
	40%	281.1 mV (280.7 to 282.4)	2	4d
	30%	210.7 mV (209.6 to 212.7)	2	4d
	20%	140.4 mV (139.8 to 141.1)	2	4d
	10%	70.2 mV (69.9 to 70.5)	2	4d
c. WHITE 85-100%		≤597.4 to ≥ 702.8 mV	2	4f
BLACK 0-15%		≤ 7.0 to ≥ 105.2 mV	2	4f
d. NOISE 50 mV		50.1 mV (45.1 to 55.1)	2	4e
350 mV		351.6 mV (343.6 to 358.6)	2	4e
LINE 331 pedestal		351.6 mV (348.1 to 355.0)		
e. MULTIBURST level		351.6 mV (348.1 to 355.0)	5	7a
700 mV total amp		702.8 mV (695.9 to 710.0) ref at 500 kHz	5	4a
420 mV pedestal		562.8 mV (557.2 to 568.3)	5	4b
Total ampl		421.9 mV (417.6 to 426.1) ref at 500 kHz	5	4b
NOISE-VARIABLE		+ & –50 mV from nominal except ≤ 14 mV of 0	3	4b
4. MODULATOR				
a. Mod Bal, all FULL FIELD signals: ≤2 mV of 4.43 MHz. Chrominance bar cross modulation ≤ 1.75 mV			4	
b. 3 bar option; P8080, pins 2 & 3 3 bar cross modulation ≤ 1.75 mV			9	1c
c. Ref bar cross modulation ≤ 1.75 mV			9	1c
5. FULL FIELD SIGNAL CHROMINANCE				
a. Line 331				
140 mV	69.7 mV	(69.0 to 70.3)	9	1b
420 mV (Packet)	207.3 mV	(205.3 to 209.4)	9	1b
420 mV (Reference)	207.3 mV	(205.3 to 209.4)	9	1b
700 mV	346.0 mV	(342.6 to 349.4)	9	1b
b. Burst				
300 mV	148.6 mV	147.3 to 150.1)	9	2

			Group	Step
c. Line 330				
280 mV	138.4 mV	(137.0 to 139.3)	9	3
d. Linearity				
280 mV	138.4 mV	(137.0 to 139.3)	9	4a
140 mV	69.7 mV	(69.0 to 70.3)	9	4b
6. RISETIME				
a. Burst envelope		323 to 431 ns	9	5a
b. T filter risetime		85 to 115 ns	8	4b
FULL FIELD SIGNAL TIMING – identical to Fig. 1-2				
7. MULTIBURST				
a. Frequency accuracy				
500 kHz	1 ~ in 4 cm ±1.2 mm at .5 μs/cm (across the bottom of the sine waves)		5	3a
1.0 MHz	2 ~ in 10 cm ±3 mm at .2 μs/cm		5	3a
2.0 MHz	2 ~ in 10 cm ±3 mm at .1 μs/cm		5	3a
4.0 MHz	4 ~ in 10 cm ±3 mm at .1 μs/cm		5	3a
4.8 MHz	3 ~ in 6.25 cm at .1 μs/cm (6.1 to 6.4)		5	3a
5.8 MHz	4 ~ in 6.9 cm at .1 μs/cm (6.8 to 7.0)		5	3a
b. MB length: 2 cycles of 500 kHz and all frequencies ending with whole cycles.			5	3b
c. MB center: 0 V average DC level on 521A Y display.			5	5a
d. MB flatness: 700 mV and 420 mV: top ±1%; bottom ±1%			5	2c, 2d
8. SIN² PULSE & BAR				
a. 2T pulse to bar ratio: 0.99 to 1.01.			8	1b
b. 20T pulse to bar ratio: 100% ± 1%.			8	2
c. 20T baseline ripple and flatness, any line: ⩽ 3.5 mV			8	2
d. 20T modulation Vector: 60° from U axis, ±5°			6	1g
e. 20T pulse: HAD 2.0 μs (1.94 to 2.06).			6	1d
f. 2T pulse: HAD 200 ns (194 to 206); amplitude within 1% of bar; ringing ⩽ 0.5%			8	1a
g. Bar tilt ⩽ 0.5% (3.5 mV) in any 10 μs period.			8	4c
9. LINE 331				
Vector: 60° from U axis, ±5°			6	1g.
10. LINEARITY				
a. 10 STEP: within 1% of nominal			7	1a
5 STEP: within 1% of nominal			7	1a
b. Diff gain: ⩽ 0.5%, diff phase: ⩽ 0.2°.			10	1, 2
11. ALT OPERATION			14	5a
12. ALT & 6 LINES FLATFIELD OPERATION			14	5b

	Group	Step
13. HARMONICS		
a. All FULL FIELD signal harmonics ⩾ 40 dB down from the reference signal.	8	3
b. Noise Spectrum flat ±6 dB to 5 MHz.	3	5
14. BOUNCE		
BOUNCE rate ⩽ 1 s to ⩾ 10 s.	2	4g
15. ITS INSERTION-DIFF PHASE & GAIN		
a. PROGRAM OUTPUT LINE: diff phase, ⩽ 0.15° and diff gain, ⩽ 0.2%.	12	1b, 1c
VAR LEVEL at max: diff phase, ⩽ 0.3° and diff gain, ⩽ 0.4%.	12	1d
b. PREVIEW OUTPUTS: diff phase, ⩽ 0.3° and diff gain, ⩽ 0.4%	12	2
16. ITS INSERTION		
a. PROGRAM OUTPUT LINE		
Gain change between PROGRAM, PREVIEW & BYPASS: Unity gain ±1%, all signals	13	2c
DC level: within 50 mV of BYPASS LEVEL	13	2b
PROGRAM flatness: within 1% of FF TEST SIGNAL	13	4b
PROGRAM ITS flatness: within 1% of FF TEST SIGNAL	13	4b
b. PREVIEW OUTPUTS		
Gain, PROGRAM OUTPUT LINE to PREVIEW MONITOR OUT: Unity gain ±1%	13	3c
DC level: within 50 mV of BYPASS LEVEL	13	3b
PREVIEW ITS flatness: within 1% of FF TEST SIGNAL	13	4a
PREVIEW flatness: within 1% of FF TEST SIGNAL	13	4a
Other PREVIEW OUTPUT		
c. INSERT SUBCARRIER PHASE		
⩾ 5° either side of 60°	13	5a
Set for no error, PROGRAM	13	5b
No error, PREVIEW	13	5b
d. Unwanted ITS Pedestal		
PROGRAM & PREVIEW: ⩽ 5 mV	13	2b
e. Amplitude Ratio, PROGRAM	13	2e
2T pulse to bar: 100% ± 0.25% (1.8 mV))		
20T pulse to bar: 100% ± 0.5% (3.5 mV)		
20T luminance to chrominance change: ⩽ 0.5%		
f. Frequency response:	13	6g
± 1% to 6 MHz;		
+1%, –6.5%, 6 MHz to 10 MHz		
g. Waveform Tilt, PROGRAM & PREVIEW	13	10
FIELD rate SQ WAVE: ⩽ 0.5%		
Line tilt ⩽ 0.25%		

	Group	Step
17. AUXILIARY PEDESTAL & UNITY GAIN-VAR LEVEL		
a. AUXILIARY PEDESTAL ⩾ −70 mV to ⩾ 630 mV	13	11
b. UNITY GAIN-VAR GAIN ⩽ 70% to ⩾ 140%, PROGRAM & PREVIEW	13	12
c. Bypass relay and LINE RATE ONLY switch.	14	4a, 4b
d. Half line insertion, PREVIEW	3	2
e. NOISE match, PROGRAM LINE to NOISE output	3	3
18. PROGRAM LINE OUT-ABERRATIONS		
a. Residual subcarrier −60 dB (⩽ 0.7 mV)	13	13a
b. Inactive part of lines −40 dB (⩽ 7 mV)	13	13b
c. Active part of lines		
Spurious −60 dB (⩽ 0.7 mV)	13	13c
FF 2T pulse −70 dB (⩽ 0.22 mV)	13	13d
FF Subcarrier (staircase) −60 dB (⩽ 0.7 mV)	13	13d
All other FF signals −60 dB (⩽ 0.7 mV)	13	13d
d. Delete mode		
2T (from a 148) −70 dB (⩽ 0.22 mV)	13	13g
Subcarrier (Colour Bars) −60 dB (⩽ 0.7 mV)	13	13g
Any int signal (rotate FF switch) −60 dB (⩽ 0.7 mV)	13	13g
e. Non-inserted lines		
Hum & power line transients −60 dB (⩽ 0.7 mV)	13	13e
f. Random noise		
−75 dB (0.14 mV or less)	13	13f
19. INSERT DELAY & TIMING		
a. Delay: Start of sync to start of NOISE or MB ITS, 11.5 to 12.5 μs with INSERT DELAY adjustment.	14	3a
b. INSERT DELAY range 1.5 μs or more.	14	1a
c. Serration width 4.7 μs ±0.2 μs Sync width 4.7 μs ±0.2 μs Equalizer width 2.35 μs ±0.1 μs	14	2
20. RETURN LOSS		
a. PROGRAM INPUT LINE, POWER off		
at least −30 dB (⩽ 16 mV) to 7 MHz	15	3e

b. Return Loss, POWER on		Group	Step
PROG, INPUT	⩽16 mV to 7 MHz	15	13f
PROG, OUTPUT	⩽16 mV to 7 MHz	15	13f
PROG, MONITORING	⩽16 mV to 7 MHz	15	13f
PREVIEW OUTPUT (both)	⩽16 mV to 7 MHz	15	13f
FULL FIELD OUT (both)	⩽10 mV to 7 MHz	15	13f
COMP SYNC	⩽16 mV to 3.6 MHz	15	13f
EXT ITS INPUT	⩽16 mV to 5 MHz	15	13f
NOISE	⩽16 mV to 5 MHz	15	13f
AUX IN	⩽16 mV to 5 MHz	15	13f
MIXED SYNCS	⩽16 mV to 5 MHz with 75Ω term	15	13f
BURST FLAG	⩽16 mV to 5 MHz with 75Ω term	15	13f
PAL PULSE	⩽16 mV to 5 MHz with 75Ω term	15	13f
SUBCARRIER	⩽16 mV to 5 MHz with 75Ω term	15	13f

CALIBRATION PROCEDURE

General

The calibration procedure is arranged in a sequence designed for calibration with minimum interaction of adjustments and reconnection of equipment. However, some adjustments affect the calibration of other circuits, and it may be necessary to check the operation of other parts of the instrument. Where adjustments interact, they are noted.

The procedure uses the equipment and fixtures listed in the Test Equipment Used list. If substitute or alternate test equipment is used, control setting or test equipment setup may need to be altered to meet the requirements of the equipment used.

The 148 front- and rear-panel control titles and signal output connectors are capitalized (e.g., COMP SYNC). Internal adjustment titles are initial capitalized only (e.g., Subcarrier Ampl).

All waveforms shown in the procedure are actual photographs taken with a TEKTRONIX Oscilloscope Projected-Graticule Camera System.

Test Equipment Used

All test equipment is assumed to be correctly calibrated and operating within the given specification. Correct operation of all test equipment is also assumed.

Test Equipment for Adjustment Steps

1. Waveform Monitor. TEKTRONIX Type 529 MOD 188D Waveform Monitor (monitor).

2. Vectorscope. TEKTRONIX Type 521A PAL Vectorscope (vectorscope).

3. Test Oscilloscope. Bandwidth, DC to at least 30 MHz; minimum deflection factor, 1 mV/division; two input channels, capable of independent or differential operation; time base, at least 0.1 μs/division and slower. TEKTRONIX Type 547 Oscilloscope with Type 1A5 Plug-In Unit (test oscilloscope).

4. Video Signal Source. Signals: PAL colour bars or modulated staircase (5 steps and 140 mV subcarrier) and ITS insertion; composite sync and subcarrier. TEKTRONIX Type 141A PAL Test Signal Generator.

5. DC Voltmeter. Capable of measuring 5 and 15 volts within 1%.

6. Chopped Voltage Reference. TEKTRONIX Calibration Fixture 067-0596-00 (chopper).

NOTE

See the 067-0596-00 Calibration Fixture instruction manual for details on obtaining a chopped signal. All chopper dial readings include a correction factor. Make final checks and adjustments with a deflection factor of 10 mV/Div.

7. Coaxial Cable (7). 75 Ω with BNC connectors (cable). TEKTRONIX Part No. 012-0074-00.

8. Termination (3). 75 Ω end-line, with BNC connectors (end-line termination). TEKTRONIX Part No. 011-0103-02.

9. Termination (2). 75 Ω feed-through with BNC connectors (feed-through termination). TEKTRONIX Part No. 011-0103-02.

10. RMS Voltmeter. Capable of measuring 70 mV to 0.14 V. HEWLETT-PACKARD Model 3400A.

11. Filter. Continuous Random Noise Measurement Low Pass Filter, Fc = 5.0 MHz. (5.0 MHz Low Pass Filter) TEKTRONIX Calibration Fixture 015-0213-00.

Test Equipment for Optional Checks

12. Variable Autotransformer. Power supply regulation, see calibration procedure GROUP 15 Step 1. Capable of supplying at least 200 volt-amperes over the desired line voltage range. GENERAL RADIO W10MT3W Metered VARIAC Autotransformer.

13. Spectrum Analyzer. Harmonics, see calibration procedure GROUP 5, Steps 1, 2, and 3; GROUP 8, Step 3; and GROUP 15, Step 5. Noise Spectrum GROUP 3, Step 5; and GROUP 15, Step 5. Center Frequency 0.1 MHz; Resolution, 100 kHz; Frequency span, at least 2 MHz/div. RF attenuation range, capable of measuring 40 dB below the reference signal. TEKTRONIX 1401A Spectrum Analyzer with a TEKTRONIX 323 Oscilloscope (or the test oscilloscope).

14. Weighting Network. Program Line Out aberrations, see calibration procedure GROUP 15, Step 5 and GROUP 3, Step 5. Continuous Random Noise Measurement Weighting Network, Fc = 5.0 MHz. (5.0 MHz Weighting Network) TEKTRONIX Calibration Fixture 015-0215-00.

15. Constant Amplitude Signal Generator. Return Loss, see calibration procedure GROUP 13, Step 12d. Output of at least 500 mV; frequency range, 50 kHz and variable from 1 MHz to 7 MHz. TEKTRONIX Type 191 Constant Amplitude Signal Generator (signal generator). Use with:

Return Loss Bridge, TEKTRONIX Part No. 015-0149-00

Minimum Loss Attenuator, 50 Ω to 75 Ω. TEKTRONIX Part No. 011-0057-00.

Calibration Aid

Table 4-3 is provided as a cross-reference between the adjustments and calibration procedure steps. If a wrong adjustment is made, this table may be used to locate that step in the procedure where it is properly adjusted. If the above situation exists, read the complete step to check for interaction of other adjustments.

TABLE 4-3

Adjustment	Function of Adjustment (most cases)	Calibration Key	
		Group	Step
C749	Program Chroma Gain	13	5c
C779	Program MB ITS Flatness	13	5c
C849	Preview Flatness	13	7d
C879	Preview MB ITS Flatness	13	8b
C3470	10 Step Amplitude	7	1a
C3565	5 Step Amplitude	7	1a
C6693	MB Harmonics	5	2g, 3c
C6788	MB Harmonics	5	3d
C7461	MB 700 mV Flatness	5	2d, h; 4c
C7463	MB 420 mV Flatness	5	2c, h; 4c
C8698	Mod Bal	4 (6)	- - (1c)
C8997	Mod Bal	4 (6)	- - (1c)
C9719	225° Phase	11	2b
L20	Comp Sync Filter	1	6
L120	Comp Sync Filter	1	6
L190	Subcarrier Amplitude	1	5
L415	20T Filter	6 (8)	1d (2)
L435	20T Filter	6 (8)	1d (2)
L455	20T Filter	6 (8)	1d (2)
L475	20T Filter	6 (8)	1d (2)
L1870	1 MHz Osc.	1	3

TABLE 4-3 (cont)

Adjustment	Function of Adjustment (most cases)	Calibration Key Group	Step
L5100	Subc Phase	6	1e
L7301	2T Filter	8	1c
L7311	T Filter	8	1b
L7401	2T Filter	8	1c
L7411	T Filter	8	1b
L7501	2T Filter	8	1c
L7511	T Filter	8	1b
L7601	2T Filter	8	1c
L7611	T Filter	8	1b
L8007	Subc Peaking	6	1d
L8066	180° Phase Advance	6	1o
L8140	V Phase	6	1e, 2b
L8150	U Phase	6	1e, 2b
L8160	Magenta Phase	6	1e, 2b
L8290	Line 331 Mod Envelope	9	5a
L8390	Line 331 Mod Envelope	9	5a
L8580	Band Pass Filter	6 (8)	1d, k, 2a (2)
L8590	Band Pass Filter	6 (8)	1i, k, 2a (2)
L8630	Insert Phase	6	1i
L8730	Burst Envelope	9	5a
L9710	135° Phase	11	2b
L9772	Subc Peaking	11	2b
R251	Equalizer Width	14	2
R351	Sync Width	14	2
R356	Serration Width	14	2
R486	20T Gain	6 (8)	1d (2)
R505	Program Gain	13	2c
R735	Diff Phase	12	1b
R765	Program Luminance Gain	13	2c, 9c
R775	Program Sync Level	13	2b
R780	Prog BW	13	6d
R785	Program DC Level	13	2b
R965	Pre Gain	13	3c, 9d
R975	Preview Sync Level	13	3b
R985	Preview DC Level	13	3b
R1978	Sync Delay	14	3
R2715	MB Length	5	3b
R3260	Noise Ampl	3	1a, b
R3270	Noise Spectrum	3	1b
R3410	280 mV Mod Amplitude	9	4a
R3420	140 mV Mod Amplitude	9	4b
R3616	Ramp Amplitude	7	1a
R5916	Sound Inhibit	11	6
R5920	4.43 MHz Adj.	11	5a
R6202	MB 1.25 MHz	5	3a
R6304	MB 500 kHz	5	3a
R6314	MB 2.5 MHz	5	3a
R6324	MB 4.0 MHz	5	3a
R6334	MB 4.8 MHz	5	3a
R6344	MB 5.8 MHz	5	3a
R6673	MB Centering	5	2b, 5a

TABLE 4-3 (cont)

Adjustment	Function of Adjustment (most cases)	Calibration Key Group	Step
R6736	MB Band Pass	5	2b
R6741	MB Gain	5	2a, e; 4a
R6833	MB Pedestal Amplitude	5 (7)	6 (1a)
R6836	MB Center Level	5	7a
R6898	MB Harmonics	5	2a, 3d
R6938	MB Setup	5	2a
R6942	MB Sync Level	5	2a, e; 5b
R6977	MB Harmonics	5	2g, 3c
R7131	2T Pulse Amplitude	8	1c
R7138	T Amplitude	8	1b
R7143	Bar Amplitude	7	1a
R7361	Auxiliary Sync Level	13	1
R7453	P & B Sync Level	6 (8)	1d (2)
R7561	Noise Match	3	3b
R7615	Mod Delay	6, 8	1i, 2a, 2
R7661	Modulation Gain	6	1i
R7733	DC Level	2	3
R7735	Reference Pedestal Amplitude	2	1
R7993	Ext ITS Gain	15	4
R8024	20T Phase	6	1g, 2b
R8028	Subc Gain	6	1h, 2b
R8071	Line 331 Ped Amplitude	7	1
R8171	Line 331, 420 mV Amplitude	9	1b
R8172	Line 331, 700 mV Amplitude	9	1b
R8271	Line 331, 140 mV Amplitude	9	1b
R8272	Line 331, Ref Amplitude	9	1b
R8381	Line 330 Chroma	9	3
R8431	Burst Amplitude	6 (9)	1i (2)
R8870	20T Chroma Gain	6 (8)	1i (2)
R8920	Sync Amplitude	2	2
R8990	Mod Bal	4 (6)	- - (1c)
R9801	+5 Volt Adj.	1	1c
R9831	+15 Volt Adj.	1	1b
R9851	−15 Volt Adj.	1	1a

Preliminary Procedure

1. Install the rear-panel REMOTE plug P9014. Allow a ten minute warmup at 25°C ± 5°C before checking or calibrating the instrument.

2. Set the 148 switches to the up or to the right position, except:

BOUNCE	BOUNCE
NORM	NORM
NOISE	OFF
FULL FIELD SIG (left)	MULTIBURST
FULL FIELD SIG (right)	FLAT FIELD
% PEAK WHITE	100
FLAT FIELD	VAR APL

3. Connect an external 1-volt peak-to-peak composite video signal to the 148 PROGRAM INPUT.

NOTE

Unless otherwise noted, connections made to the 148 are via a 75 Ω coaxial cable.

4. From the 148 rear-panel FULL FIELD TEST SIGNAL OUT connector, connect a cable to the monitor input; loop-through, with another cable, to the vectorscope input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

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NOTE

Unless otherwise stated, 148 signals to the test oscilloscope are through a cable, terminated with a feed-through termination at the test oscilloscope input.

5. Externally trigger the test oscilloscope with composite sync.

6. Connect the video signal source composite sync signal to the monitor Ext Sync Input; connect the loop-through, with another cable, to the vectorscope Ext Sync Input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

7. Connect the video signal source subcarrier to the vectorscope Ext ϕ Ref Input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

NOTE

Preliminary steps 2 through 7 is the basic setup for this procedure. If no setup is given at the start of a step, use this one.

GROUP 1-INITIAL

NOTE

Do not adjust the power supplies if they are within the listed tolerances. Adjustment of any supply will affect the operation of other circuits within the instrument. If a complete recalibration is being performed, set each voltage to the exact setting.

1. Check/Adjust Power Supply Voltage

a. Connect a precision DC Voltmeter between chassis ground (pin 1 of P9834) and P9852 (−15 volts), see Fig. 4-4.

CHECK—Voltage should be −15 volts within 1% (−14.85 to −15.15 V).

ADJUST—R9851 (−15 Volt Adj) for −15 volts.

b. Connect the voltmeter between chassis ground and P9832 (+15 volts).

CHECK—Voltage should be +15 volts within 1% (14.85 to 15.15 V).

ADJUST—R9831 (+15 Volts Adj) for +15 volts.

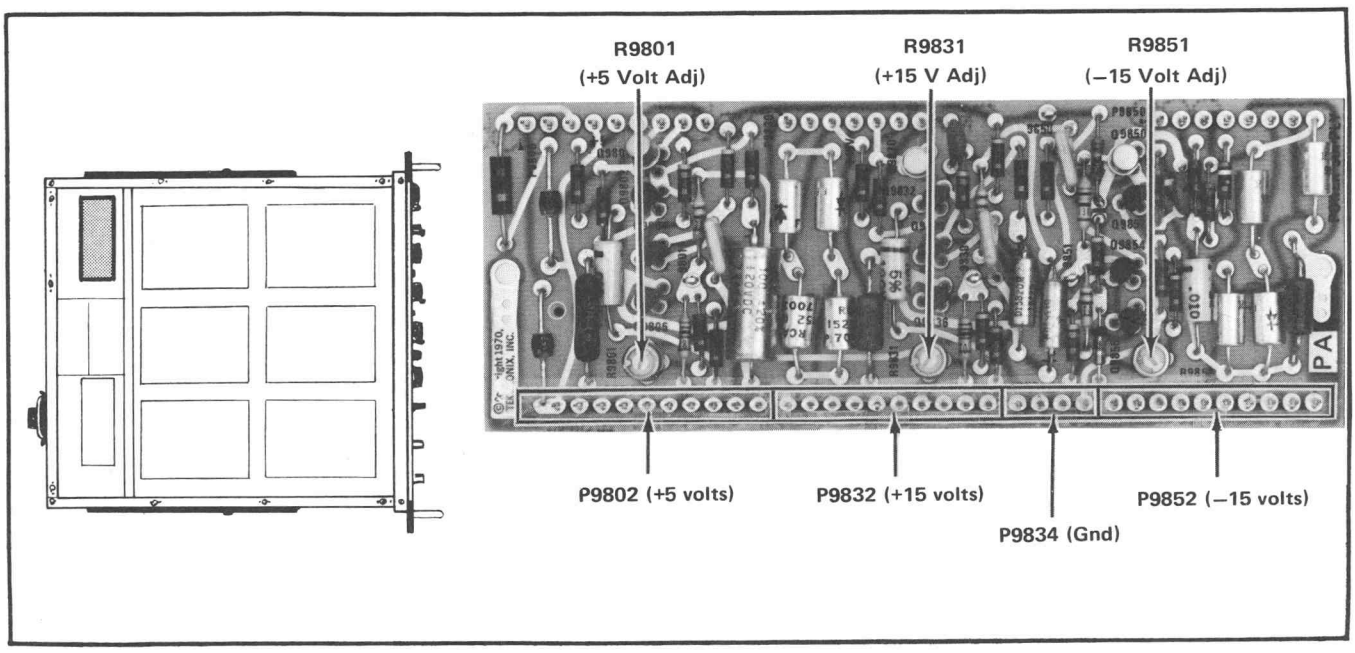

Fig. 4-4. Power Supply test point and adjustment locations.

c. Connect the voltmeter between chassis ground and P9802 (+5 volts).

CHECK—Voltage should be +5 volts within 1% (4.95 to 5.05 V).

ADJUST—R9801 (+5 Volts Adj) for +5 volts.

d. Repeat the above adjustments to remove any interaction.

2. Check Power Supply Ripple

Use a 1X probe, between the supply under test and the test oscilloscope.

CHECK—Power line related ripple at these plugs:

Plug	Supply	Max Ripple
P9852	−15 V	10 mV
P9832	+15 V	10 mV
P9802	+5 V	10 mV

3. Check/Adjust 1 MHz Oscillator Lock

Establish a 0-volt (ground) reference point on the test oscilloscope. Connect a 10X probe to the collector of Q1820, see Fig. 4-5.

CHECK—Display DC level should be approximately +2.5 V.

ADJUST—L1870 (1 MHz Osc) to position the display midway between the two levels at which the oscillator free-runs, (one level near +5 V DC and the other near 0 V DC).

4. Check/Adjust INSERT DELAY Range

Connect the 10X probe to the back of the FULL FIELD TEST SIGNAL OUT connector. Display the full-field signal and establish a horizontal timing reference point.

CHECK—Rotation of the INSERT DELAY control, through its range, should move the display 1 μs or more.

ADJUST—INSERT DELAY control to electrical mid-range.

5. Check/Adjust Subcarrier Amplitude

Display the 148 CW SUBCARRIER OUT on the test oscilloscope.

CHECK—Subcarrier amplitude should be between 1.8 and 2.2 volts peak-to-peak.

ADJUST—L190 (Subcarrier Ampl), see Fig. 4-6, for a subcarrier amplitude of 2 volts peak-to-peak.

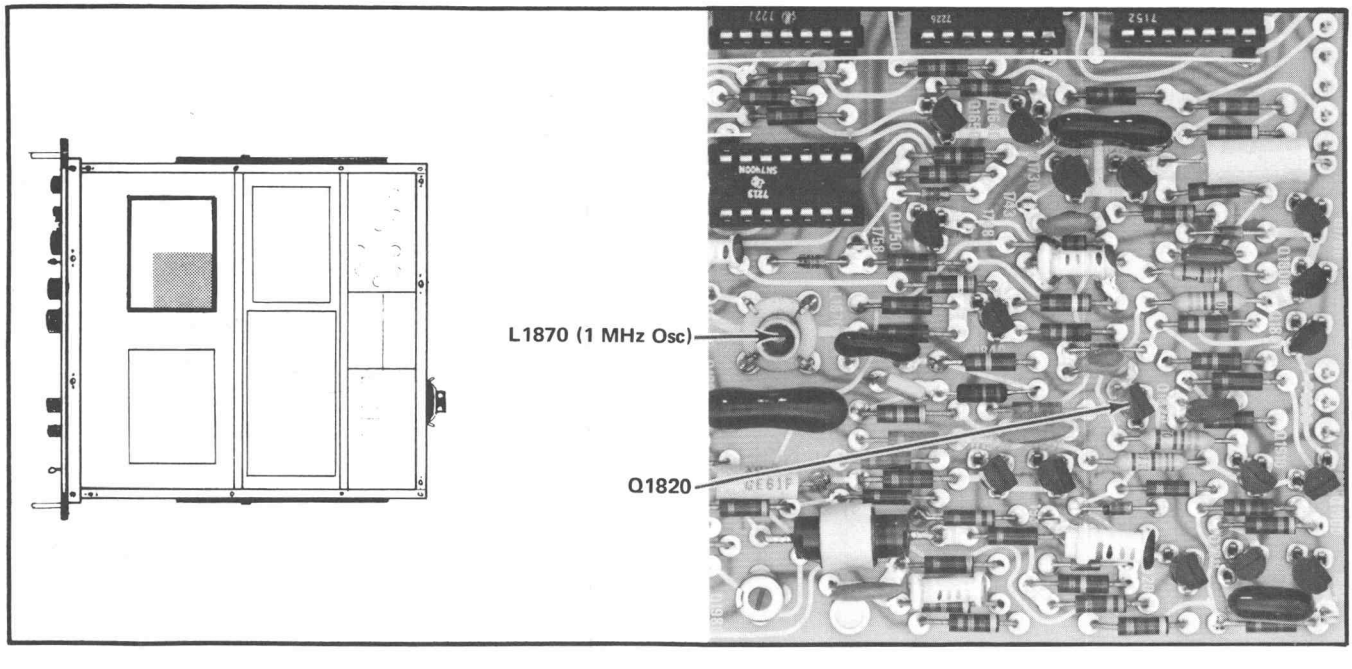

Fig. 4-5. Vertical Counter test point and adjustment locations.

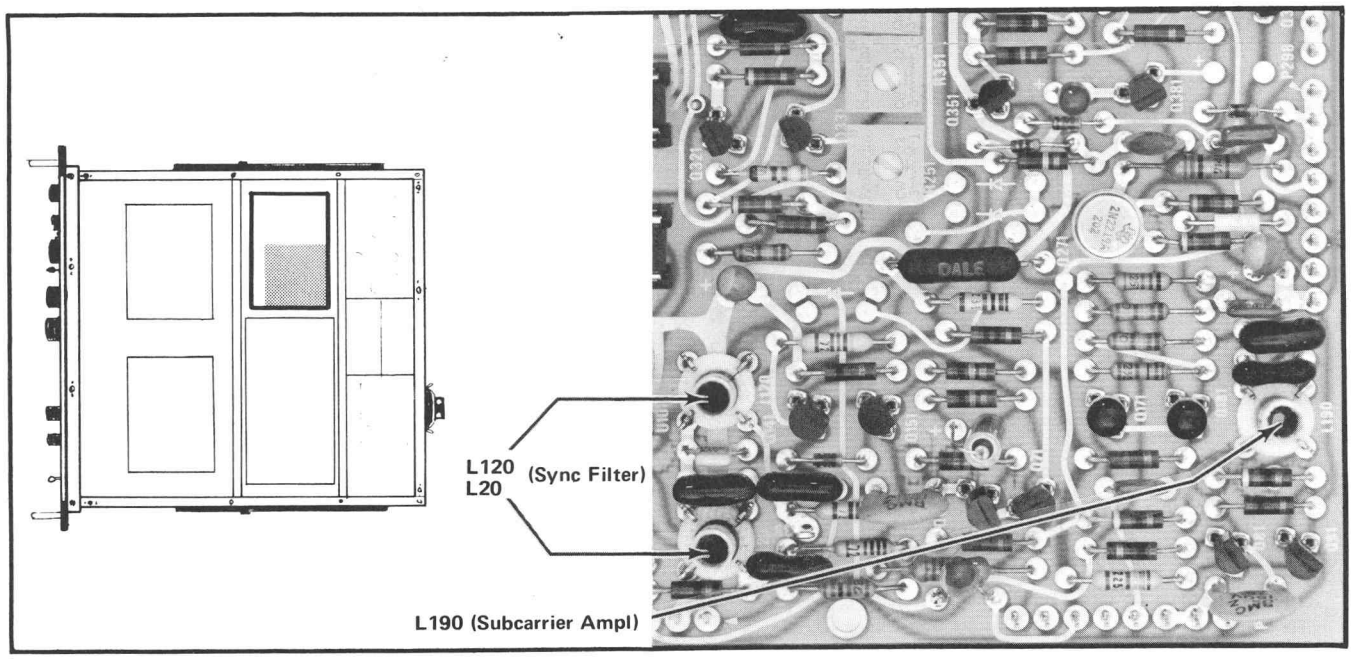

Fig. 4-6. Subcarrier & Sync adjustment locations.

6. Check/Adjust Composite Sync

Display the 148 COMP SYNC on the test oscilloscope.

CHECK—Composite Sync amplitude should be between 4 and 5 volts peak-to-peak.

CHECK—Aberrations on leading corner of the sync should be 4%, or less, of the total amplitude.

ADJUST—L20 and L120 (Sync Filter), see Fig. 4-6, for the best square corner on the leading edge of sync with aberrations 4% or less.

GROUP 2-OUTPUT AMPLITUDES

1. Check/Adjust Pedestal Amplitude

Display the rear-panel FULL FIELD TEST SIGNAL on the test oscilloscope. Connect the chopper to the test oscilloscope and display the chopped signal. Set R7453 (P & B Sync Level), see Fig. 4-7, to midrange.

NOTE

See the 067-0596-00 Calibration Fixture instruction manual for details on obtaining a chopped signal. All Chopper dial readings include a correction factor. Make final checks and adjustments with a deflection factor of 10 mV/Div.

CHECK—Pedestal amplitude should be between 695.9 and 710.0 mV (700 mV within 1%).

ADJUST—R7735 (Reference Ampl), see Fig. 4-7, for a pedestal amplitude of 702.8 mV (700 mV).

2. Check/Adjust Sync Amplitude

CHECK—Sync amplitude should be between –298.0 and –304.0 mV (300 mV within 1%).

ADJUST—R8920 (Sync Ampl), see Fig. 4-8, for a sync amplitude of –301.0 mV (300 mV).

3. Check/Adjust Output DC Level

a. Set the test oscilloscope to display only the 148 signal. Establish a 0 volt (ground) reference.

CHECK—Blanking level should be 0 volts within 50 mV.

ADJUST—R7733 (DC Level), see Fig. 4-7, to position the blanking level to 0 volts.

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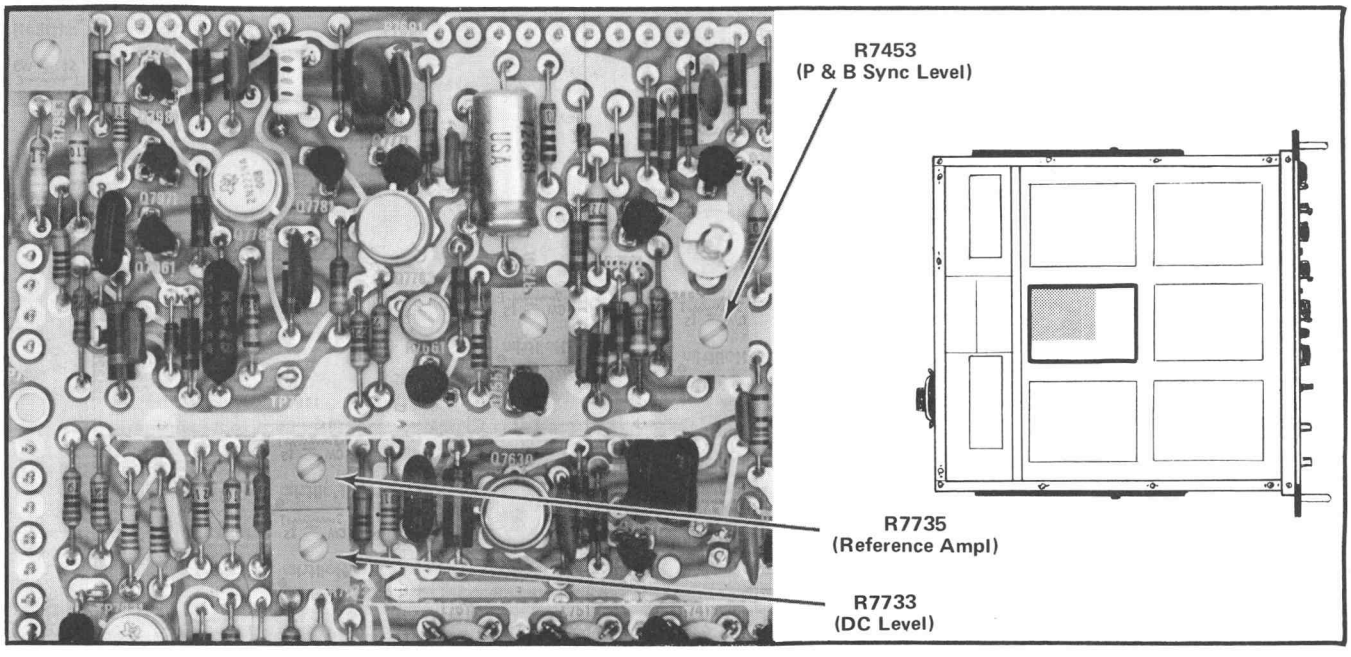


Fig. 4-7. Output Amplifier adjustment locations.

b. Set the test oscilloscope to display the chopped signal.

CHECK—Pedestal amplitude should be between 695.9 and 710.0 mV (700 mV within 1%).

4. Check FULL FIELD SIGNAL Outputs

a. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope.

b. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope. Set the FULL FIELD SIG switch to FIELD SQ WAVE.

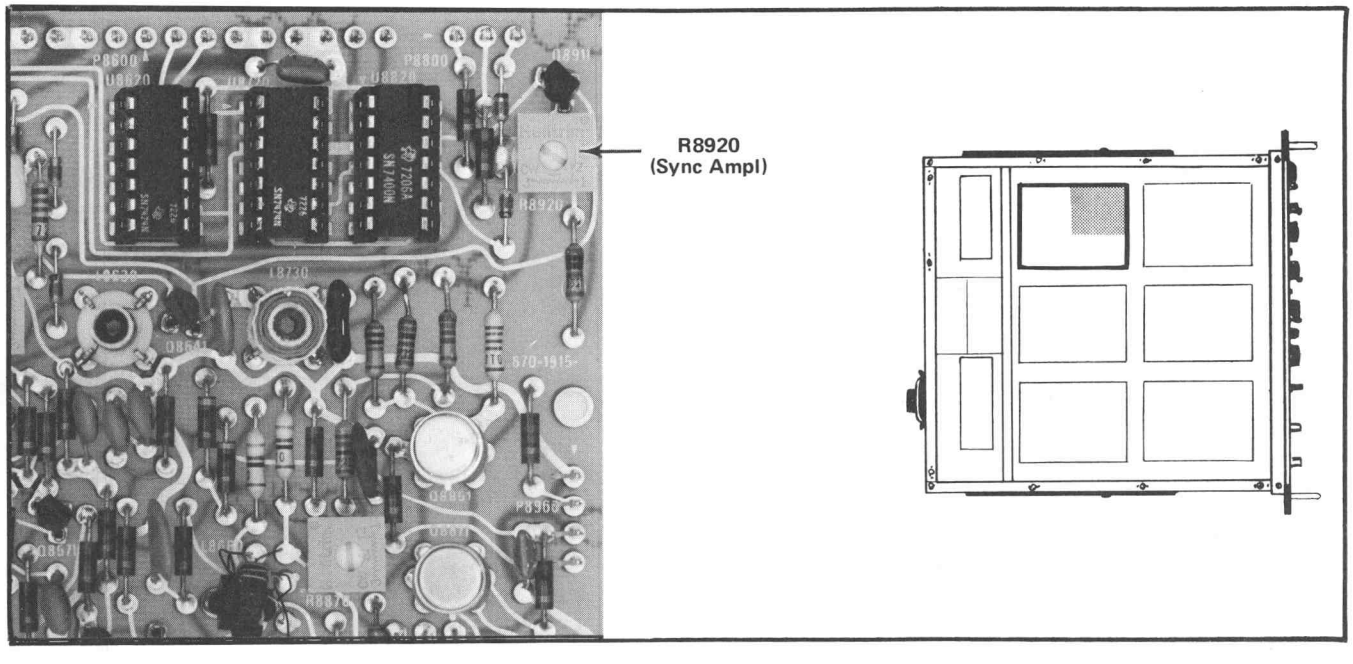


Fig. 4-8. Sync adjustment location.

CHECK—Pedestal amplitude should be between 695.9 and 710.0 mV (700 mV within 1%).

c. Set the FULL FIELD SIG switch to NOISE.

CHECK—700 mV PEDESTAL should be between 689.0 and 717.2 mV (700 mV within 2%).

d. Set the FULL FIELD SIG switch to FLAT FIELD, VAR APL.

CHECK—

90% within 0.5%	629.9 to 636.2 (644.1 mV)
80% within 0.5%	560.6 to 565.5 (562.8 mV)
70% within 0.5%	489.7 to 494.5 (492.1 mV)
60% within 0.5%	419.8 to 424.0 (421.9 mV)
50% within 0.5%	349.8 to 353.3 (351.7 mV)
40% within 0.5%	280.7 to 282.4 (281.1 mV)
30% within 0.5%	209.6 to 212.7 (210.7 mV)
20% within 0.5%	139.8 to 141.1 (140.4 mV)
10% within 0.5%	69.9 to 70.5 (70.2 mV)

e. Set the FULL FIELD SIG switch to NOISE.

CHECK—NOISE pedestal amplitude as follows:

350 mV within 2%	343.6 to 358.6 (351.6 mV)
50 mV within 5 mV	45.1 to 55.1 (50.1 mV)

f. Set the FULL FIELD SIG switches for FLAT FIELD, PRESET, and BLACK.

CHECK—BLACK adjustment range 0% to 15% (less than 7 mV to more than 105.2 mV).

CHECK—WHITE adjustment range 85% to 100% (less than 597.4 to more than 702.8 mV).

g. Set the FULL FIELD SIG switch to BOUNCE. Adjust BOUNCE RATE to maximum CW.

CHECK—Bounce level is either the selected white level or the selected black level.

CHECK—Bounce rate is variable from 1 second or less, at maximum CW, to 10 seconds or more, at maximum CCW.

5. Check Full-Field Signal Timing

Using Fig. 1-2 of this manual as a guide, check that each full-field signal generated by the 148 has been horizontally programmed as shown.

GROUP 3—NOISE

1. Check/Adjust Noise Level Accuracy

a. Set the FULL FIELD SIG switch to NOISE. Set the NOISE switches for −20 dB of inserted noise. Connect (in listed order) from the 148 NOISE OUT, a 75 Ω coaxial cable, 5.0 MHz Low Pass Filter, 75 Ω Termination, and the RMS Voltmeter.

CHECK—Noise output should be 70 mV RMS within 1 dB.

ADJUST—R3260 (Noise Amplitude), see Fig. 4-9, for 70 mV RMS.

NOTE

Verification of the NOISE LEVEL switches accuracy requires misadjustment of the noise amplitude.

b. Set R3260 (Noise Amplitude) for a 0 dB reference on the RMS Voltmeter. Use R3270 (Noise Spectrum) if needed.

CHECK—Noise level should be within 1 dB of the front-panel indication.

ADJUST—R3260 (and R3270) for 70 mV RMS.

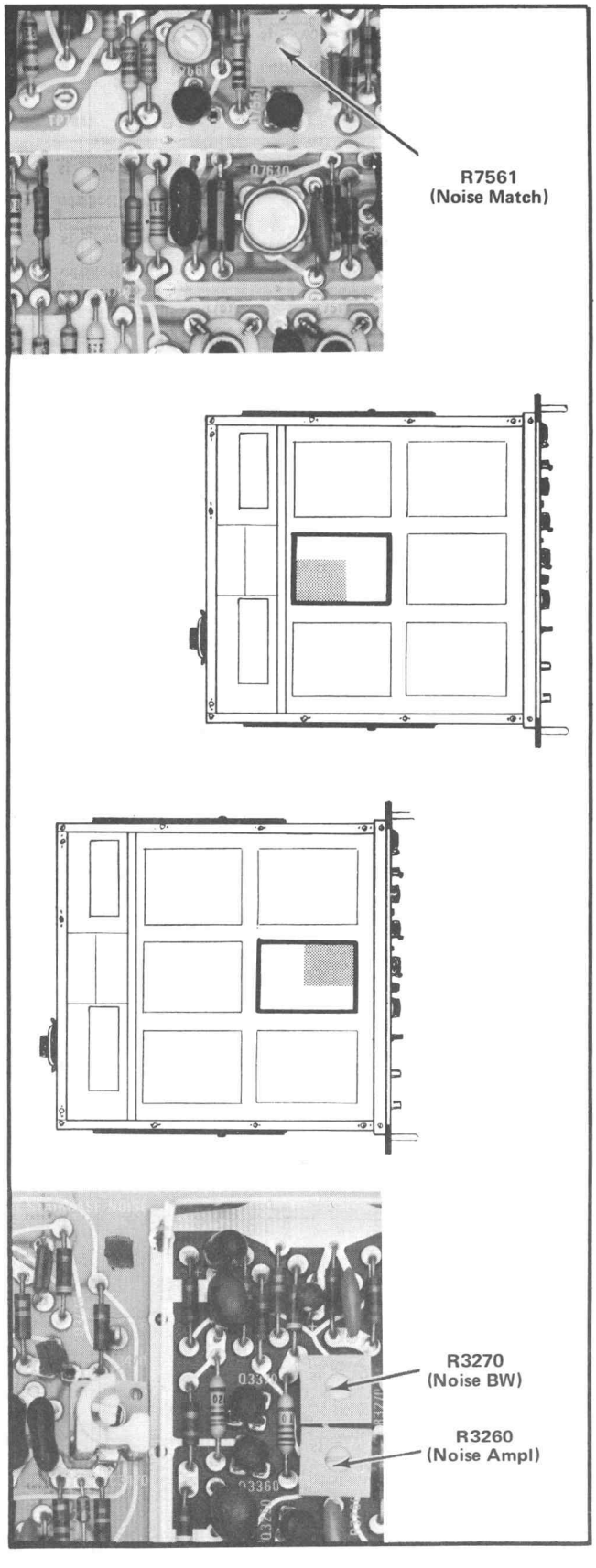


Fig. 4-9. Noise adjustment location.

2. Check Half-Line Insertion

Display the PREVIEW OUTPUT signal on the monitor. Set the INSERTION SIGNAL CONTROL switch to PREVIEW. Set the FULL FIELD SIG switch to NOISE.

CHECK—Half-line of noise should be displayed in the middle of the line (NOISE INSERTION) or a full-line of noise pedestal (NOISE DELETION).

3. Check/Adjust Noise Match

a. Connect the video signal source composite sync, Burst Flag, PAL Pulse, and 4.43 MHz to the 148 respective inputs. Set the SYNC switch to EXT.

b. Connect the noise out signal to the PROGRAM INPUT. Set the noise pedestal to match the baseline. Insert –20 dB of noise.

CHECK—Noise amplitudes match.

ADJUST—R7561 (Noise Match), see Fig. 4-9, to match the half-line noise amplitude to the PROGRAM LINE noise.

4. Check VARIABLE Pedestal Control

a. Display the FULL FIELD TEST SIGNAL on the monitor. Insert noise, but set the NOISE LEVEL switch to OFF.

CHECK—VAR control range should be from –50 mV to +50 mV (CW) at each pedestal level, except the 50 mV position, which should have range to 14 mV or less.

b. Set the VARIABLE control for minimum amplitude and the PEDESTAL switch to 50 mV.

CHECK—Baseline transients should be 32 mV or less.

5. Check Noise Spectrum

The noise spectrum should be flat to 5 MHz within 6 dB. See GROUP 15, Step 5.

GROUP 4–MODULATOR BALANCE

Display the front-panel FULL FIELD TEST SIGNAL on the test oscilloscope.

CHECK–Each position of the FULL FIELD SIG switch for a modulation amplitude of 2.5 mV or less on the blanking level. If the modulation on the blanking level is acceptable, go to GROUP 5.

ADJUST–C8997, R8990, and C8698 (Mod Bal) in listed order, for minimum residual subcarrier in all positions of the FULL FIELD SIG switch. (See Fig. 4-10 for adjustment locations.)

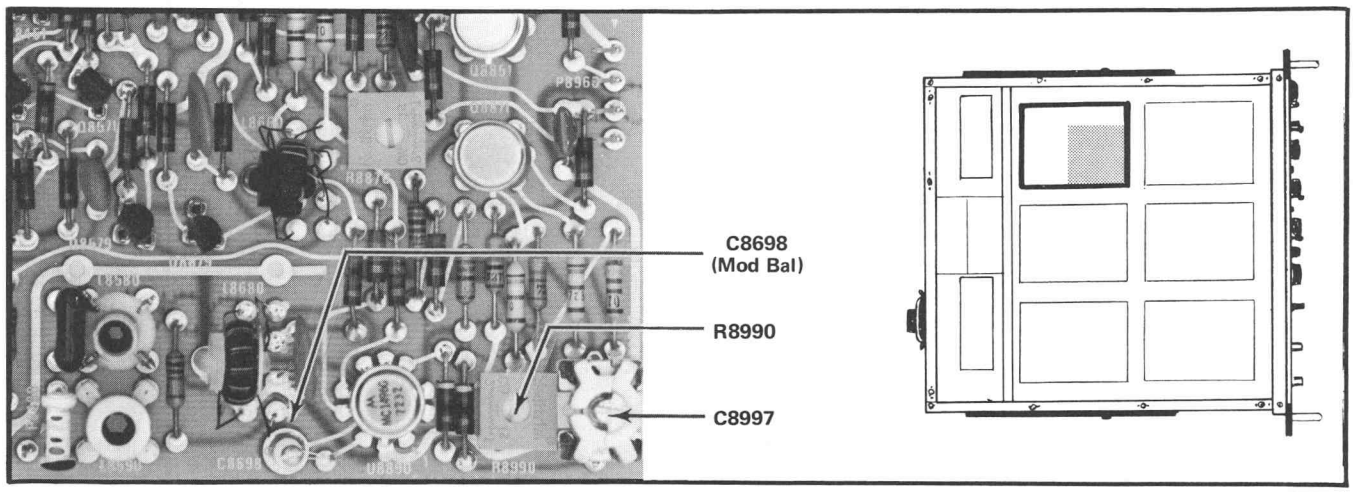


Fig. 4-10. Modulator balance adjustment location.

GROUP 5-MULTIBURST

1. Check Multiburst Amplitude and Frequency

a. Set the FULL FIELD SIG switch to MULTIBURST. Display the rear-panel FULL FIELD SIGNAL on the test oscilloscope and the front-panel FULL FIELD SIGNAL OUTPUT on the monitor and vectorscope.

CHECK–Multiburst Amplitude; 500 kHz burst should be between 417.6 and 426.1 mV (420 mV within 1%).

b. Set the MULTIBURST AMPLITUDE switch to 700 mV.

CHECK–Multiburst accuracy as follows.

Burst	Tolerance	Test Oscilloscope Display
500 kHz	3%	1 ~ in 4 div ±0.12 div at 0.5 μs/div (across thebottom of the sinewaves)
1.0 MHz	3%	2 ~ in 10 div ±0.3 div at 0.2 μs/div
2.0 MHz	3%	4 ~ in 10 div ±0.3 div at 0.1 μs/div
4.0 MHz	3%	4 ~ in 10 div ±0.3 div at 0.1 μs/div
4.8 MHz	3%	3 ~ in 6.1 to 6.4 div at 0.1 μs/div
5.8 MHz	2%	4 ~ in 6.8 to 7.0 div at 0.1 μs/div

CHECK–Harmonics should be at least 40 dB below the reference signal. See GROUP 15, Step 5.

c. If these requirements are met go to Step 4c.

2. Preset Multiburst

NOTE

The adjustments in this step affect the harmonic content of the Multiburst signal. Only slight adjustment from the original calibration should be attempted without using a spectrum analyzer. See GROUP 15, Step 5, for further information. In addition, if more than a slight adjustment is made to the listed controls, check the following:

Control	Check	Group	Step
R6942 (MB Sync Level)	P & B Mod Bal	5	2f
R6741 (MB Gain)	P & B Level	5	2e

a. Set R6938 (MB Setup Level) to maximum CW.

NOTE

Refer to Fig. 4-12 for all adjustments in this group.

b. Adjust R6673 (MB Centering) to match the level of the 5.8 MHz burst to the 0 reference level on the vectorscope Y display, see Fig. 4-11.

ADJUST—R6736 (MB Bandpass) for best flat top between bursts, i.e., adjust so that any tilt between the first and last burst packets is minimum.

c. Set the MULTIBURST AMPLITUDE switch to 420 mV.

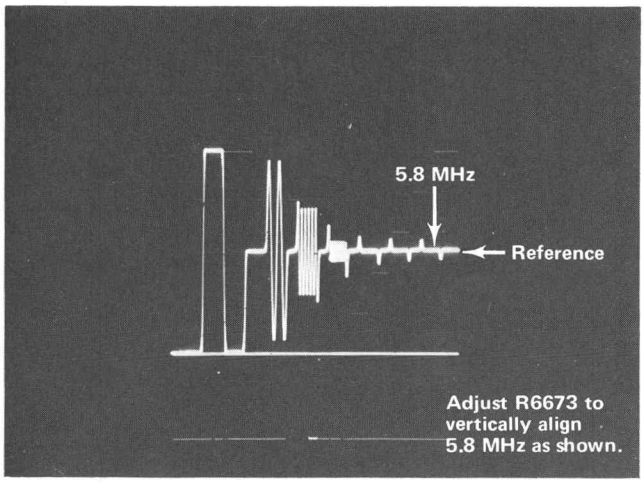


Fig. 4-11. Typical vectorscope display (Y) of Multiburst luminance.

ADJUST—C7463 (MB 420 mV Flatness) for the best average flat response, top and bottom, on the monitor display.

d. Set the MULTIBURST AMPLITUDE switch to 700 mV.

ADJUST—C7461 (MB 700 mV Flatness) for the best average flat response, on the monitor display.

e. Adjust R6741 (MB Gain) for exactly 700 mV of the 500 kHz burst. Refer to the NOTE following step 2.

f. Adjust R6942 (MB Sync Level) to overlay the multiburst front porch and the 0 reference level (baseline) of the monitor display. Refer to the NOTE following step 2.

g. Adjust R6977 (MB Harmonics) for best multiburst bottom.

ADJUST—C6693 (MB Harmonics) for best multiburst top, on the monitor display. Refer to the NOTE following step 2.

h. Readjust C7463, then C7461, for best flat multiburst at 420 mV and 700 mV, using the monitor display.

i. Repeat parts b and c.

3. Adjust Frequencies and Harmonics

a. ADJUST—Frequencies in the sequence given.

Adjust	Tolerance	Test Oscilloscope Display
R6304 (500 kHz)	±3%	1 ~ in 4 div ±0.12 div (across the bottom of the sinewaves)
R6202 (1.0 MHz)	±3%	2 ~ in 10 div ±0.3 div
R6314 (2.0 MHz)	±3%	4 ~ in 10 div ±0.3 div
R6324 (4.0 MHz)	±3%	4 ~ in 10 div ±0.3 div
R6334 (4.8 MHz)	±3%	3 ~ in 6.25 div (6.1 to 6.4 div)[3]
R6344 (5.8 MHz)	±2%	4 ~ in 6.9 div (6.8 to 7.0 div)

[3] This can be set by using the vectorscope and adjusting R6334 for a null on the vector display.

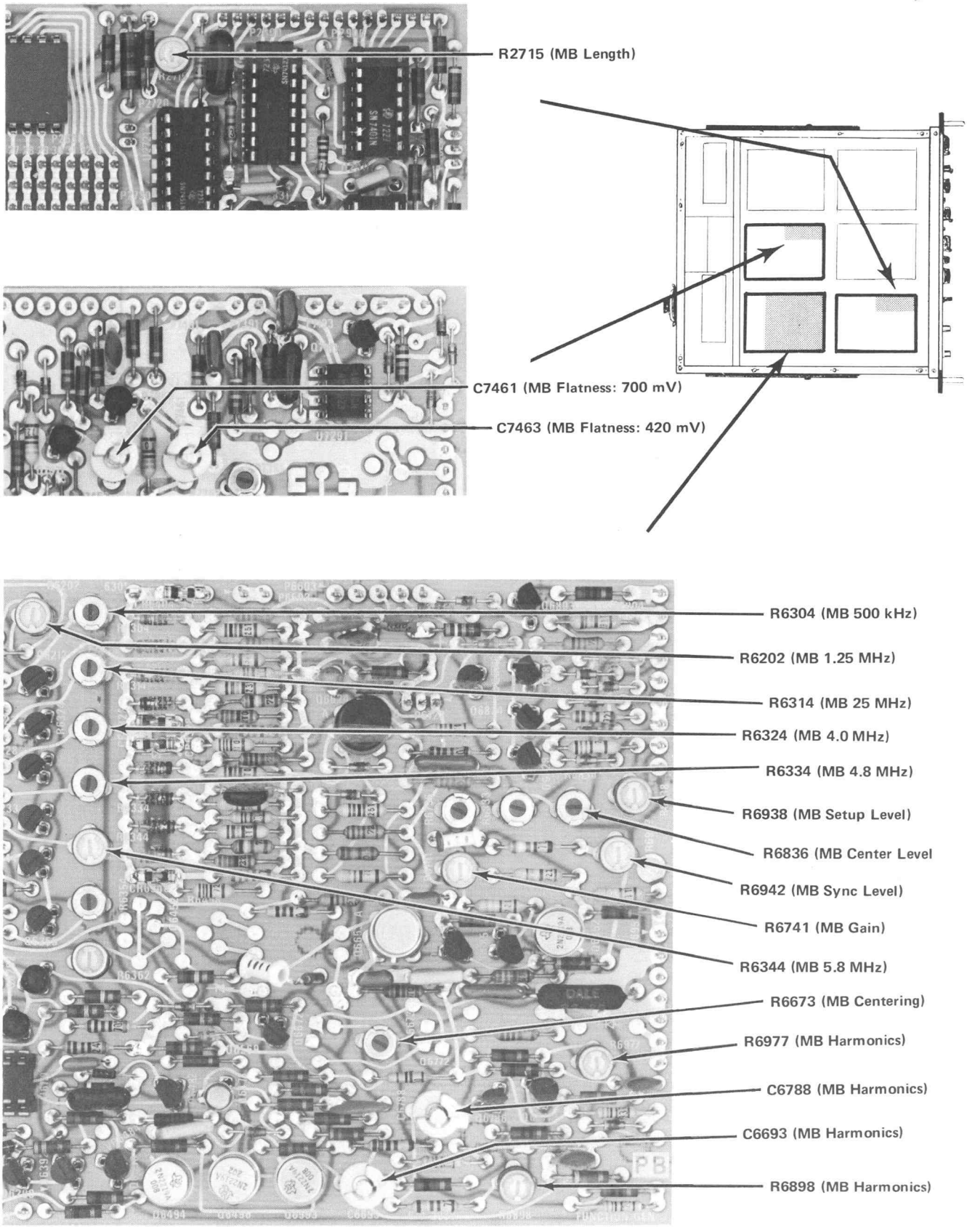


Fig. 4-12. Multiburst adjustment location.

b. ADJUST—R2715 (MB Length) to 2 cycles of 500 kHz burst and whole cycles for the remaining bursts.

c. ADJUST—R6977 (Harmonics) and C6693 (Harmonics) for best harmonic content and multiburst flatness.

d. ADJUST—R6898 (Harmonics) and C6788 (Harmonics) for best harmonic content and multiburst flatness.

e. Repeat parts 2b through 3d as needed.

4. Check/Adjust Multiburst Amplitude

a. CHECK—Burst Amplitude should be 700 mV within 1% (695.9 to 710.0 mV at the 500 kHz burst).

ADJUST—R6741 (MB Gain) for a multiburst amplitude of 702.8 mV (700 mV).

b. Set the MULTIBURST AMPLITUDE switch to 420 mV.

CHECK—Amplitude should be 420 mV within 1% (417.6 to 426.1 mV).

c. CHECK—MB flatness at 420 mV and 700 mV amplitudes should be within 1% at the top and 1% at the bottom.

ADJUST—C7463 (420 mV) and C7461 (700 mV) for best multiburst flatness within 1%.

NOTE

Adjusting C7463 and C7461 does not affect the multiburst frequency. However, the harmonic content will be greater with positive multiburst tilt.

b. CHECK—Multiburst back porch matches the 0 V DC output level on the monitor display.

ADJUST—R6942 (MB Sync Level) to match the MB back porch to the 0 V DC output level.

6. Check/Adjust Multiburst Pedestal Amplitude

CHECK—Multiburst pedestal amplitude should be 700 mV within 1% (695.9 to 710.0 mV).

ADJUST—R6833 (MB Pedestal Ampl) for a pedestal amplitude of 702.8 mV (700 mV).

7. Check/Adjust Multiburst Center Level

a. CHECK—Average multiburst center level should be 350 mV within 1% (348.1 to 355.0 mV).

ADJUST—R6836 (MB Center Level) for a center level of 351.6 mV (350 mV).

b. Set the MULTIBURST AMPLITUDE switch to 420 mV.

CHECK—420 mV average level should be 560 mV within 1% (557.2 to 568.3 mV).

5. Check/Adjust Multiburst Zero Levels

a. Set the MULTIBURST AMPLITUDE switch to 700 mV.

CHECK—Level of 5.8 MHz burst matches the 0 reference level on the vectorscope Y display, see Fig. 4-11.

ADJUST—R6673 (MB Centering) to match the level of the 5.8 MHz burst to the 0 reference level.

GROUP 6–MODULATED PULSE CHROMINANCE

1. Preset Chrominance

a. Set the FULL FIELD SIG switch to WINDOW. Display the rear-panel FULL FIELD TEST SIGNAL on the test oscilloscope and the front-panel FULL FIELD SIGNAL OUT signal on the monitor and vectorscope.

b. Refer to Fig. 4-13 for all adjustments in this group.

c. CHECK–Modulation on baseline should be less than 2.5 mV.

ADJUST–C8997, R8990, and C8698 (Mod Bal) for minimum modulation on the blanking level.

d. (Calibration Procedure Only) Disconnect plug P8490 to disable modulator. Preset R486 (20T Gain) for a 350 mV pulse. Adjust L415, L435, L455, and L475 (20T Filter) for a symmetrical 20T pulse.

CHECK–20T pulse Half Amplitude Duration (HAD); should be between 1.94 and 2.06 μs.

ADJUST–R486 (20T Gain) for 350 mV of 20T luminance (351.6 mV). Reconnect plug P8490.

e. Display the LINE 17 SIGNAL vectors on the vectorscope. Preset the 148 INSERT SUBCARRIER PHASE, L5100 (ITS Phase), L8630 (Insert Phase), L8160 (Magenta Phase), L8140 (V Phase), and L8150 (U Phase) to electrical midrange.

f. Connect a 10X probe between TP8403 and the test oscilloscope.

ADJUST–L8007 (Subc Peak) for maximum subcarrier.

g. Connect the 10X probe to TP8033.

ADJUST–R8024 (20T Phase) for a null.

h. Connect the 10X probe to TP8043.

ADJUST–R8028 (Subc Gain) for a null.

i. ADJUST–R7615 (Mod Delay) to symmetrical modulation at the bottom of the 20T Pulse. (Use monitor display.)

ADJUST–L8580 (Bandpass Filter) for maximum chrominance on the 20T Pulse.

ADJUST–L8590 (Bandpass Filter) for the best flat bottom on the 20T Pulse.

ADJUST–R8431 (Burst Ampl) to midrange.

ADJUST–R7661 (Mod Gain) for a burst amplitude of 300 mV.

ADJUST–R8870 (20T Chroma Gain) for a 20T Pulse amplitude of 700 mV as measured between blanking and the 20T Pulse peak.

ADJUST–R7453 (P & B Sync Level) to match the blanking levels.

k. ADJUST–L8580 and L8590 for minimum opening of the vectorscope display.

l. CHECK–Harmonics should be $\geqslant$ 40 dB with $\leqslant$ 3.5 mV (0.5%) baseline ripple.

m. Change P8055 90°.

n. Readjust the following controls:

R8024 (20T Phase) for a null at TP8033.

R8028 (Subc Gain) for maximum at TP8043.

R7615 (Mod Delay) for symmetrical modulation of the bottom of the 20T Pulse, on the monitor.

L8580 (Bandpass Filter) for maximum chroma.

L8590 (Bandpass Filter) for 20T Pulse flat bottom on the monitor.

R8431 (Burst Amp) to midrange.

R7661 (Mod Gain) for 300 mV burst amplitude.

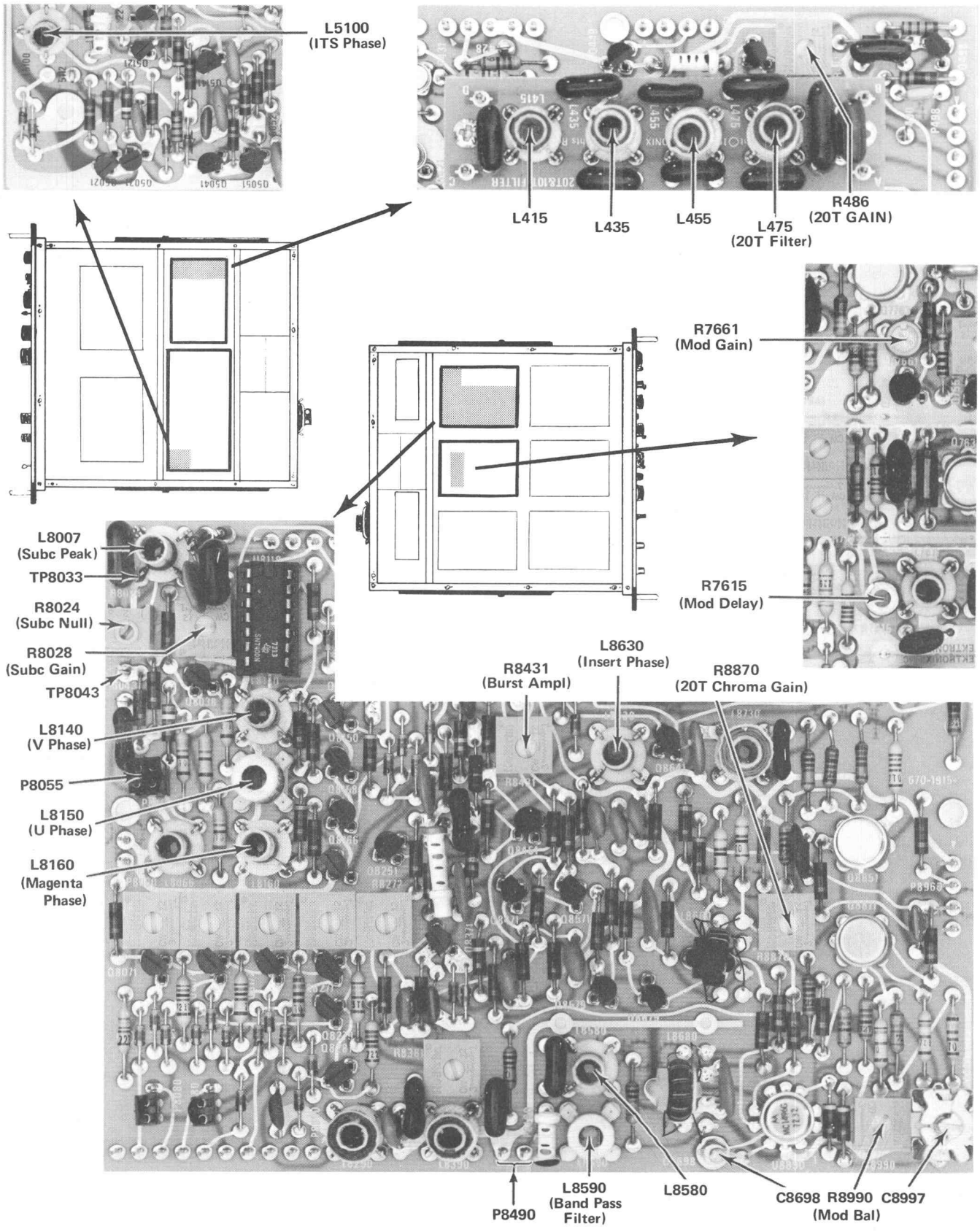


Fig. 4-13. Modulated pulse adjustment pin connector and plug location.

R8870 (20T Chroma Gain) for 700 mV 20T Pulse.

R7453 (P & B Sync Level) to match blanking levels on the monitor.

o. ADJUST—L8580 and L8590 (Bandpass Filter) for minimum vector openings, harmonics ≥ –40 dB and baseline ripple ≤ 3.5 mV (0.5%). R7615 can be readjusted as needed for minimum baseline ripple.

Move P8055 90° and adjust L8066 (180° Phase Advance) for 180° phase change when P8055 is rotated 90°. Check for 20T Pulse baseline ripple ≤ 3.5 mV (0.5%).

2. Check/Adjust Modulation Delay and Var Mod Filters

a. Display the bottom of the 20T Pulse on the monitor.

CHECK—Baseline ripple on the bottom of the pulse is 3.5 mV or less.

ADJUST—R7615 (Mod Delay) for symmetrical modulation on the 20T Pulse.

NOTE

Adjustment of L8580 and L8590 affects the harmonic content of the FULL FIELD TEST SIGNAL. Only slight adjustment from the original calibration should be attempted without a spectrum analyzer. See GROUP 15, Step 5, for information.

ADJUST—L8580 and L8590 (Bandpass Filter) for minimum vector openings and harmonics 40 dB or more below the reference signal.

b. Observe the vectorscope display. Align V Phase (135°) and U Phase (225°) on their corresponding graticule lines.

CHECK—Phase angles:

Magenta	60° within 5°
LINE 17	60° within 5°
LINEARITY	60° within 5°
LINE 331	60° within 5°

ADJUST—L8160 (Mg Phase), L8140 (V Phase), and L8150 (U Phase) for a 135° V Phase vector, a 225° U Phase vector, and a 60° magenta vector.

ADJUST—R8024 (20T Phase) and R8028 (Subc Gain) for a LINE 17 vector of 60° (magenta) within 5°.

CHECK—LINE 331 and LINEARITY for 60° vectors within 5°.

GROUP 7—LUMINANCE

1. Check/Adjust FULL FIELD TEST SIGNAL Amplitudes

a. Set the FULL FIELD SIG switch to FLAT FIELD. Set the APL switch to VARIABLE and the VARIABLE switch to 100. Display the rear-panel FULL FIELD TEST SIGNAL on the test oscilloscope and the front-panel FULL FIELD SIGNAL OUT signal on the monitor. Set the chopper amplitude to match the FLAT FIELD amplitude; should be between 695.9 and 710.0 mV.

CHECK—Amplitudes should be as given below.

Signal	Amplitude
MULTIBURST	695.9 to 710.0 mV (700 mV within 1%)
WINDOW	695.9 to 710.0 mV (700 mV within 1%)
LINEARITY	
RAMP	695.9 to 710.0 mV (700 mV within 1%)
10 STEP	695.9 to 710.0 mV (700 mV within 1%)
5 STEP	695.9 to 710.0 mV (700 mV within 1%)
LINE 17 SIGNAL	
BAR	695.9 to 710.0 mV (700 mV within 1%)
5 STEP	695.9 to 710.0 mV (700 mV within 1%)
LINE 330 SIGNAL	
BAR	695.9 to 710.0 mV (700 mV within 1%)
LINE 331 SIGNAL	
PEDESTAL	348.1 to 355.0 mV (350 mV within 1%)

ADJUST—Amplitudes as given below. See Fig. 4-14 for adjustment locations.

Signal	Adjust	Amplitude
MULTIBURST	R6833 (MB Ped Ampl)	Match FLAT FIELD setting
WINDOW	R7143 (Bar Ampl)	Match FLAT FIELD setting
LINEARITY		
RAMP	R3616 (Ramp Ampl)	Match FLAT FIELD setting
10 STEP	C3470 (10 Step Ampl)	Match FLAT FIELD setting
5 STEP	C3565 (5 Step Ampl)	Match FLAT FIELD setting
LINE 331 SIGNAL		
PEDESTAL	R8071 (Ped Ampl)	351.6 mV (350 mV)

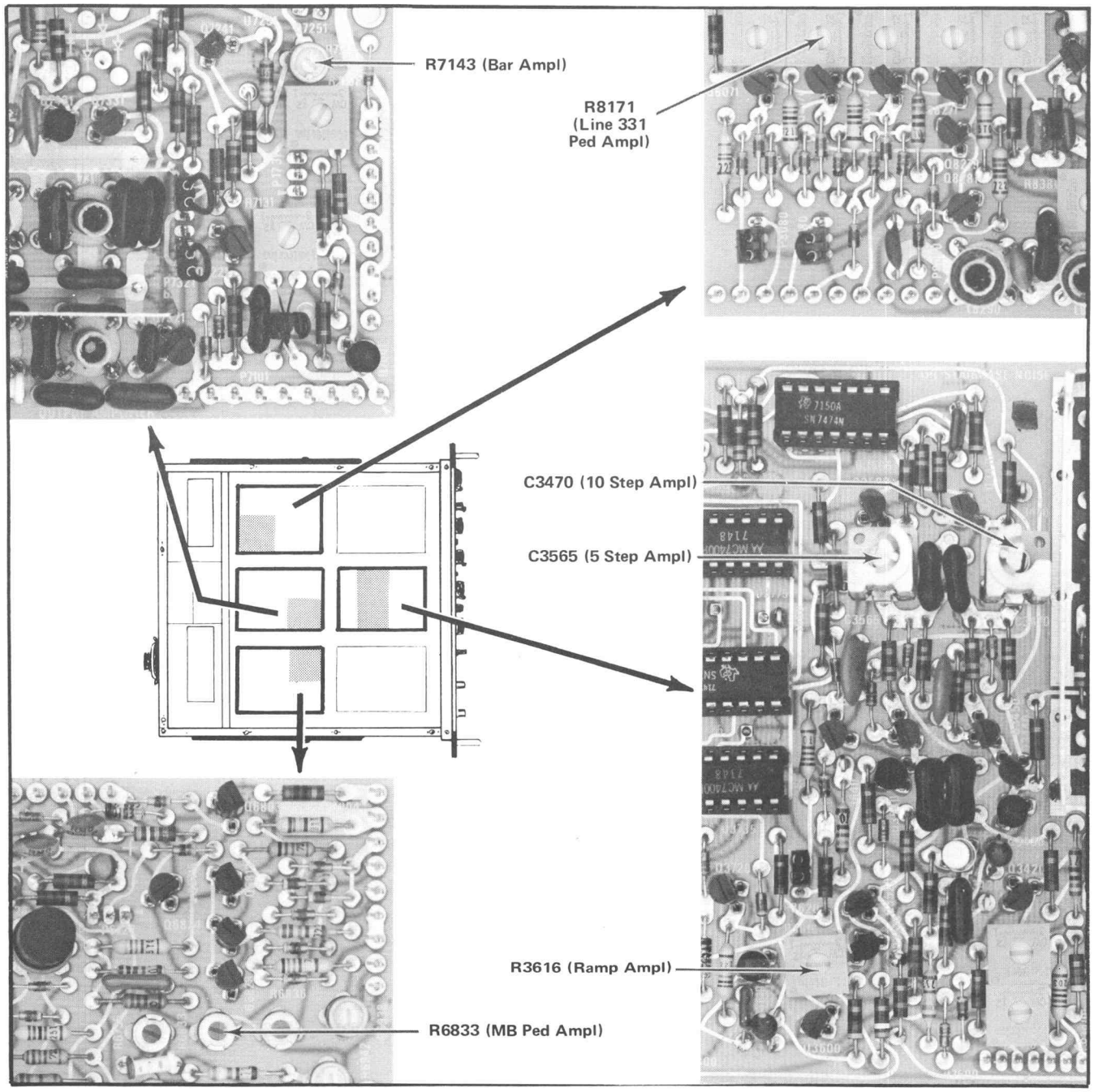


Fig. 4-14. Luminance adjustment location.

GROUP 8—PULSE AMPLITUDE AND WIDTH

1. Check/Adjust 2T and T Pulse Amplitude and Width

a. Set the FULL FIELD SIG switch to WINDOW. Display the rear-panel FULL FIELD TEST SIGNAL on the monitor for amplitude and ringing measurement. Display the front-panel FULL FIELD SIGNAL OUT signal on the test oscilloscope for pulse width measurement.

CHECK—2T Pulse to the characteristics given:

Amplitude: within 1.0% of bar;

HAD: 200 ns (194.0 to 206.0 ns);

Ringing: 0.5% or less.

b. Change the connector on P7131 to pins 2 and 3 and the connector on P7321 to pins 4 and 5.

NOTE

See Fig. 4-15 for adjustments and pin connector locations for this group.

CHECK—T Pulse to the characteristics given:

Amplitude: within 1.0% of bar;

HAD: 100 ns (94.0 to 106.0 ns);

Ringing: 1% or less.

ADJUST—L7311, L7411, L7511, and L7611 for a T Pulse HAD of 100.0 ns (94.0 to 106.0 ns); ringing, 1% or less.

ADJUST—R7138 (T Pulse Amplitude) to match the bar amplitude within 1%.

c. Change the connector on P7131 to pins 1 and 2 and the connector on P7321 to pins 5 and 6.

ADJUST—L7301, L7401, L7501, and L7601 for a 2T Pulse HAD of 200 ns (194.0 to 206.0 ns); ringing, 1% or less (7.0 mV).

ADJUST—R7131 (2T Pulse Amplitude) to match the bar amplitude within 1%.

2. Check/Adjust Sin^2 (Modulated) Pulse

CHECK—Sin^2 Pulse to the characteristics given:

Amplitude: within 1% of bar;

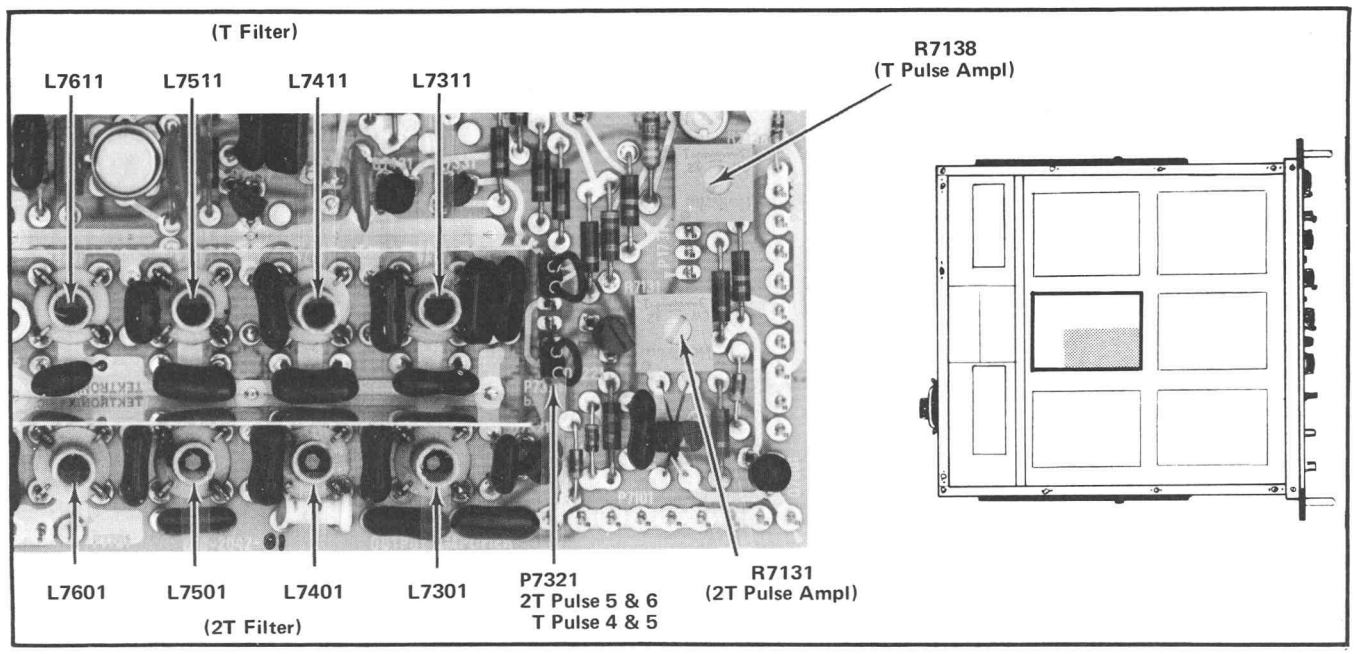


Fig. 4-15. Filter pin connectors and adjustment location (connection between pins 1 & 2 of P7321 produces T bar; pins 2 & 3 produces 2T bar).

HAD: 2.0 μs within 0.06 μs;

Baseline Ripple: 3.5 mV or less.

ADJUST—R7615 (Mod Delay); L8580, L8590 (Bandpass Filter); R8870 (20T Chroma Gain); R486 (20T Gain); R7453 (P & B Sync Level); and L415, L435, L455, L475 (20T Filter) for a Sin^2 Pulse with characteristics given. (Refer to the adjustment sequence in GROUP 6, and Fig. 4-13.)

3. Check Harmonics

At this point in the procedure, all full-field signal harmonics should be 40 dB or more below the reference signal. See GROUP 15, Step 5 for information.

4. Check WINDOW Risetimes

a. Set the FULL FIELD SIG switch to WINDOW. Change the connector on P7321 to pins 1 and 2. Use the test oscilloscope to check that the bar goes through the T filter.

CHECK—Bar risetime should be 100 ns within 15% (85 to 115 ns).

b. Change the connector on P7321 to pins 2 and 3.

CHECK—Bar risetime should be 200 ns within 15% (170 to 230 ns).

c. CHECK—Bar tilt should be 3.5 mV (0.5%) or less in any 10 μs period.

GROUP 9—CHROMINANCE

NOTE

Chrominance accuracy is based on a ratio of the luminance bar to a specific number. The numbers given are for a 350 mV bar.

1. Check/Adjust LINE 331 Amplitude

a. Set the FULL FIELD SIG switch to LINE 331.

b. Display the rear-panel FULL FIELD TEST SIGNAL on the test oscilloscope. Connect the chopper to the test oscilloscope. Display the chopped waveform. (See NOTE following item 6 of the Test Equipment Used list.) See Fig. 4-16 for adjustment locations.

CHECK—LINE 331 Chrominance

1st bar = within 1% of $\frac{\text{lum bar}}{5}$ =70.2 mV (68.8 to 71.6 mV)

2nd bar = within 1% of $\frac{3 \text{ lum bar}}{5}$ =210.7 mV (206.4 to 214.9)

3rd bar = within 1% of lum bar =351.6 mV (344.5 to 358.6 mV)

Reference bar = within 1% of $\frac{3 \text{ lum bar}}{5}$ =210.7 mV (206.4 to 214.9)

ADJUST—

R8271 (LINE 331, 140 mV Ampl)	70.2 mV
R8171 (LINE 331, 420 mV Ampl)	210.7 mV
R8272 (LINE 331, Ref Ampl)	210.7 mV
R8172 (LINE 331, 700 mV Ampl)	351.6 mV

c. LINE 331 Options

Move P8080 and O8180 to pins 1 and 2.

CHECK—should be a chrominance bar of 700 mV amplitude.

CHECK—Chrominance bar cross modulation, should be 1.75 mV or less.

Move P8080 and P8180 to pins 2 and 3.

CHECK—Should be a three-level chrominance bar.

CHECK—Chrominance bar cross modulation, should be 1.75 mV or less.

CHECK—Reference bar cross modulation, should be 1.75 mV or less.

2. Check/Adjust Burst Amplitude

CHECK—Burst Amplitude should be 300 mV ±1%; −150.5 mV (147.5 to 153.5 mV).

ADJUST—R8431 (Burst Ampl) for 150.5 mV.

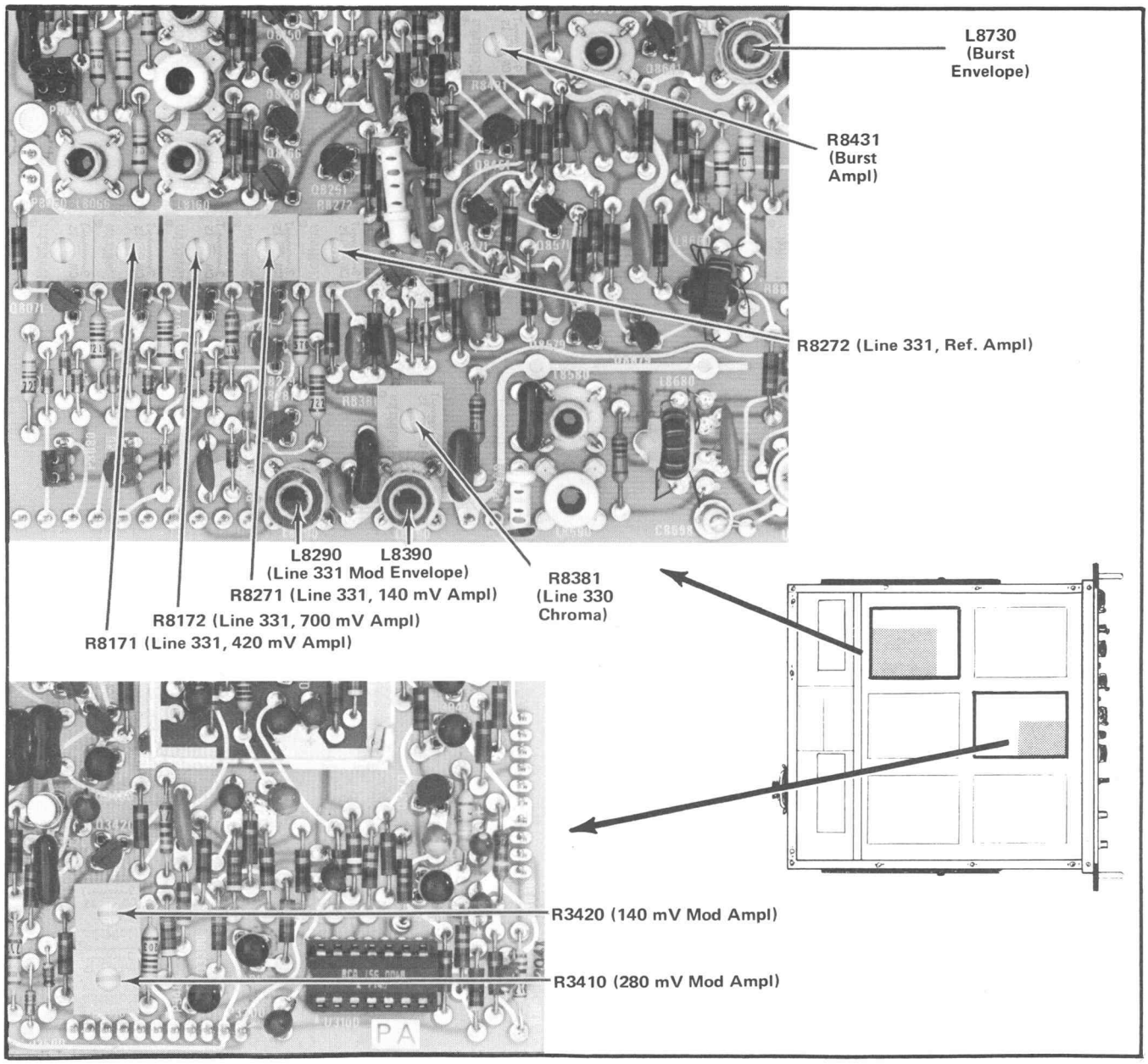


Fig. 4-16. Chrominance adjustment location.

3. Check/Adjust LINE 330 Amplitude

Set the FULL FIELD SIG switch to LINE 330 SIGNAL.

CHECK—LINE 330 chrominance should be 280 mV ±1%; —140.5 mV (137.6 to 143.3).

ADJUST—R8381 (LINE 330 Chroma) for 140.5 mV.

4. Check/Adjust LINEARITY Subcarrier Amplitude

a. Set the FULL FIELD SIG switch to LINEARITY and the SUBCARRIER AMPLITUDE switch to 280 mV.

CHECK—Subcarrier amplitude should be 280 mV within 1%; —140.5 mV (137.6 to 143.3 mV).

ADJUST—R3410 (280 mV Mod Ampl) for a subcarrier amplitude of 140.4 mV.

b. Set the SUBCARRIER AMPLITUDE switch to 140 mV.

CHECK—Subcarrier amplitude should be 140 mV within 1%; —70.2 mV (68.8 to 71.6 mV).

ADJUST—R3420 (140 mV Mod Ampl) for a subcarrier amplitude of 70.2 mV.

5. Check Chrominance Envelope

a. Set the FULL FIELD SIG switch to LINE 331 SIGNAL.

CHECK—Burst envelope risetime should be between 323 and 431 ns.

ADJUST—L8730 (Burst Envelope) for best wave shape and envelope risetime between 323 and 431 ns.

b. CHECK—Modulation envelope risetime should be between 0.85 and 1.15 μs.

ADJUST—L8290 and L8390 (LINE 331 Mod Envelope) for best wave shape and envelope risetime between 0.85 and 1.15 μs

GROUP 10—FULL FIELD DIFF GAIN & PHASE

Refer to the Preliminary Procedure for setup.

1. Check Diff Gain

Set the FULL FIELD SIG switch to LINEARITY. Set the vectorscope to measure differential gain.

CHECK—Diff gain should be 0.5% or less.

2. Check Diff Phase

Set the vectorscope to measure differential phase.

CHECK—Diff phase should be 0.2° or less.

GROUP 11—GEN LOCK

NOTE

This group of checks requires a video signal source with the ability to shut off its burst and/or sync.

1. Check Light and Output Operation

a. Display the video signal source colour bars on the monitor.

CHECK—NOT LOCKED TO PROGRAM light is extinguished and the PROGRAM light should be lit. There should be ITS.

b. Turn off the video signal source sync.

CHECK—NOT LOCKED (red) light is lit; the PROGRAM lamp should be lit. There should be no 148 ITS. There should be no subcarrier or composite sync outputs from the 148.

c. Turn the video signal source sync on and the U burst off.

CHECK—PROGRAM light should be lit. There should be ITS. There should be composite sync output, but no subcarrier output.

d. Turn the video signal source U burst on.

CHECK—There should be a subcarrier output.

e. Disconnect the video signal source.

CHECK—Loss of 148 ITS and that the 148 Full-Field signal is on PROGRAM OUT LINE signal, in PROGRAM mode.

CHECK—Burst is present on the Full-Field signal.

2. Check INT/EXT SYNC Mode

a. Connect appropriate 2 V signals from the video signal source to the COMP SYNC, BURST FLAG, PAL PULSE, and 4.43 MHz INPUTS.

CHECK—TP5698, see Fig. 4-17, for 2 pulses, matching in time and width, but with an amplitude ratio of about 5:6.

b. Set the SYNC switch to EXT.

CHECK—TP5698 for 2 pulses with some similarity to the pulses in INT mode.

ADJUST—L9710 (135° Phase) for maximum pulse amplitude; C9719 (225° Phase) to match pulse amplitude and L9772 (Subc Peaking) for flat pulse tops and similarity to the pulses in INT mode.

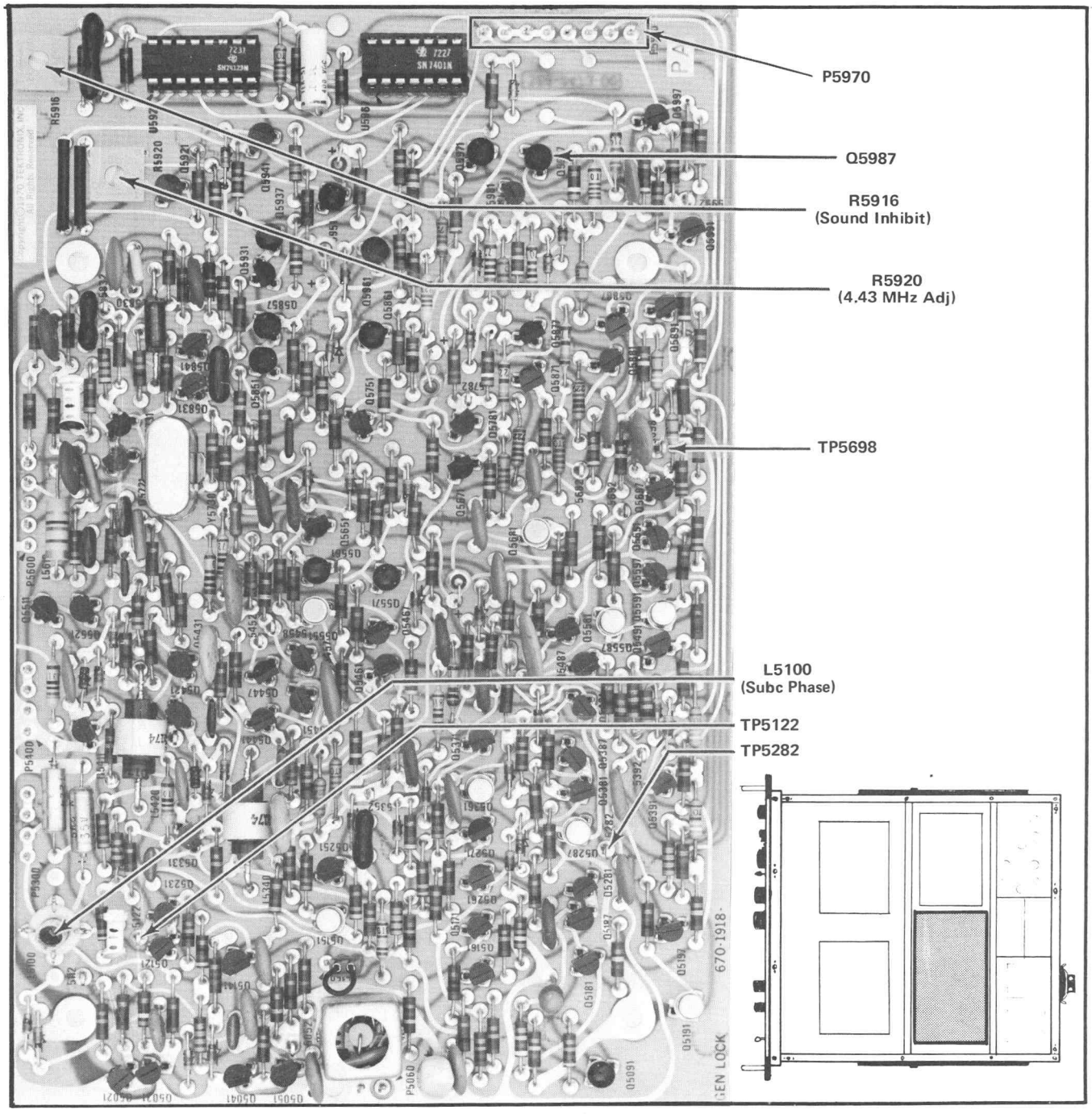


Fig. 4-17. Gen Lock test point, pin connector and adjustment location.

NOTE

The adjustments for this step are on the small circuit board just forward of the external sync input connectors.

c. Remove, then reconnect the input signals, one at a time.

CHECK—Removal of any of the 4 external sync signals will remove the pulses from TP5698.

d. Leave all external signals connected and set the SYNC switch in EXT.

3. Check Sync Stripper Operation

a. Connect a 10X probe to TP5282.

CHECK—Composite sync amplitude should be between 0.8 and 1.2 V.

b. Connect the probe to plug P5970, pins 2, 3, or 4.

CHECK—Composite sync amplitude should be between 5.0 and 6.0 V.

c. Set the SYNC switch to INT.

CHECK—

P5970	comp sync 5.0 to 6.0 V
TP5282	comp sync 0.8 to 1.2 V

4. Check Chroma AGC Ratio

NOTE

R5920 (4.43 MHz Adj) is adjusted to make the chroma change easier to see. If it is adjusted, reset it using Step 5.

a. Connect a 10X probe to TP5332. Remove Q5987 and adjust R5920 for a chroma variation of about once a second.

CHECK—Burst amplitude ratio should not vary more than 1:1.6.

b. Replace Q5987.

5. Adjust 4.43 MHz Frequency

a. Monitor the Full-Field signal on the vectorscope. Turn the video signal source U burst off.

ADJUST—R5920 (4.43 MHz Adj) for minimum vector rotation. 4.43361875 MHz ±25 Hz.

b. Turn the video signal source U burst on.

6. Check/Adjust Sound Inhibit

Connect a 10X probe to P5970, pins 2, 3, or 4. Display the trailing edge of sync on the test oscilloscope.

CHECK—Sound Inhibit pulse for a trailing edge 275 ns (250 to 300 ns) before the trailing edge of sync.

NOTE

This is a very low writing rate display. If the Sound Inhibit pulse trailing edge cannot be seen, display the signal at U5967B, pin 6, on the test oscilloscope and note its position. Move the probe to U5967B, pin 5, and check for 275 ns between the two signals.

ADJUST—R5916 (Sound Inhibit) for a trailing edge of 275 ns before the trailing edge of sync.

GROUP 12–ITS INSERTION, DIFF PHASE AND DIFF GAIN

1. Check/Adjust PROGRAM LINE OUT

a. Set the video signal source for a full-field modulated staircase test signal. Display the PROGRAM OUTPUT LINE signal on the monitor and vectorscope.

b. Set the vectorscope to measure differential phase.

CHECK–Diff Phase should be 0.15° or less.

ADJUST–R735 (Diff Phase), see Fig. 4-18, for minimum differential phase 0.15° or less.

c. Set the vectorscope to measure differential gain.

CHECK–Diff Gain should be 0.2% or less.

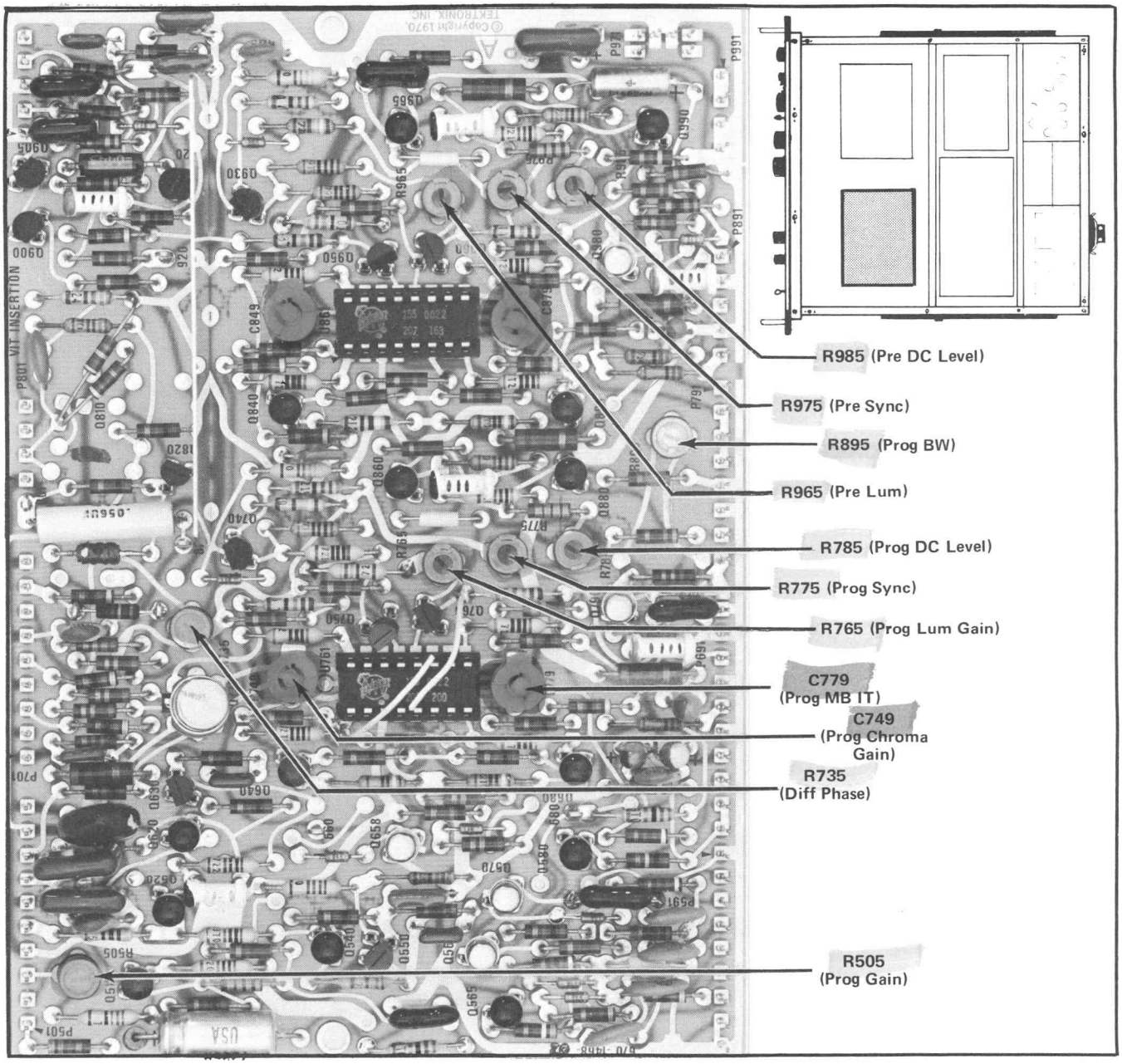


Fig. 4-18. Auxiliary sync level and external VITS gain adjustment location.

d. Set the VAR LEVEL to max. Repeat the checks in 1b and 1c except:

CHECK—Diff Phase should be 0.3° or less.

CHECK—Diff Gain should be 0.4% or less.

Set VAR LEVEL controls for unity gain.

2. Check PREVIEW OUTPUTS

Display the PREVIEW OUT signal on the monitor. Repeat the checks in Step 1b and c except:

CHECK—Diff Gain should be 0.4% or less.

CHECK—Diff Phase should be 0.3° or less.

3. Check Programming

a. Display the PROGRAM LINE OUT SIGNAL on the monitor.

CHECK—ITS exist as indicated in Table 4-4 ITS and FF LOGIC.

b. Using Table 4-4 as a guide, check that all internal connectors (as factory connected) are in the appropriate position.

TABLE 4-4

Factory Connected Internal Changes

Board Pin No.	Plug	Pins Nos.	Function
SUBC & SYNC			
P482	Red	1 & 2 (Outbd)	FF Burst-Insert
GEN LOCK			
P5150	Blue	1 & 3 (Fwd)	Subc Lock-Normal
APL, STAIRCASE & NOISE			
P3620	Black	1 & 2 (Outbd)	Slow Ramp
P3760	Black	(Fwd)	Staircase
OUTPUT			
P7131	Gray	1 & 2 (Outbd)	2T Pulse
P7321	Violet	1 & 2 (Inbd)	T Bar
P7321	Gray	5 & 6 (Outbd)	2T Pulse
MODULATOR			
P8055	Black	(Fwd)	0 180° Advance
P8080	Brown	2 & 3 (Outbd)	LINE 331
P8180	Brown	2 & 3 (Outbd)	3 Bar
ITS & FF LOGIC			
LINE 330	Brown Diode	F2, F4	
	Brown	17,330	
LINE 17	Red Diode	F1, F3	
	Red	17,330	
MULTIBURST	Orange Diode	F1, F3	
	Orange	18,331	
LINE 331	Yellow Diode	F2, F4	
	Yellow	18,331	
EXT	Green Diode	F1, F3	
	Green	OFF	
NOISE	Blue Diode	F1, F3	
	Blue	19,332	

GROUP 13—ITS INSERTION

NOTE

The adjustments and checks in this group, except Step 1, require that any errors in the full-field signal be noted or adjusted out.

Display the vertical interval of the rear-panel FULL FIELD TEST SIGNAL on the monitor. If the back porch of the Multiburst and Sin^2 Pulse & Bar signals are not superimposed with the blanking level they will show up as unwanted ITS pedestal error (Steps 2b and 3b).

Small errors may be adjusted out without further recalibration. Adjust R6942 (MB Sync Level), see Fig. 4-12; adjust R7453 (P & S Sync Level), see Fig. 4-19.

The full-field signal output DC level should be close to 0 V. Adjust R7733 (DC Level), see Fig. 4-7.

All adjustments, except step 1, are shown in Fig. 4-18.

1. Check/Adjust Auxiliary Sync Level

Display the vertical interval of the PREVIEW OUT signal on the monitor.

CHECK—Display should be similar to the display shown in Fig. 4-19.

ADJUST—R7361 (Aux Sync Level), see Fig. 4-19, to match the levels as shown in Fig. 4-20.

2. Check/Adjust PROGRAM OUTPUT LINE

a. Display the vertical interval of the PROGRAM OUTPUT LINE signal on the monitor. Connect appropriate signals from the video signal source to the COMP SYNC, BURST FLAG, PAL PULSE, and 4.43 MHz INPUTS. Connect a cable from the rear-panel FULL FIELD TEST SIGNAL to the PROGRAM INPUT.

b. Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to 100. (Set sync switch to EXT.)

CHECK—ITS blanking level (unwanted ITS pedestal) should be within 5 mV of the blanking level for the non-inserted lines.

ADJUST—R775 (Prog Sync Level) to match the blanking levels.

CHECK—Blanking level (DC) should not change more than 50 mV when switching the INSERTION CONTROL between PROGRAM and BYPASS.

ADJUST—R785 (Prog DC Level) so that no blanking level (DC) change occurs when switching between PROGRAM and BYPASS.

NOTE

The blanking level seen in the BYPASS mode is not necessarily 0 volts, but rather the blanking level of the full-field signal.

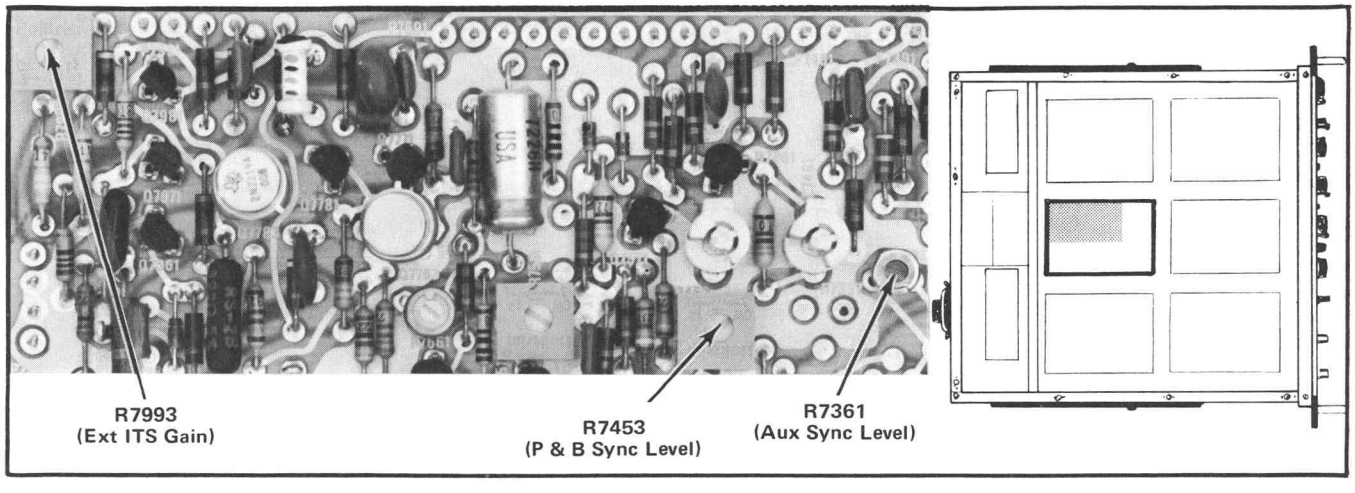
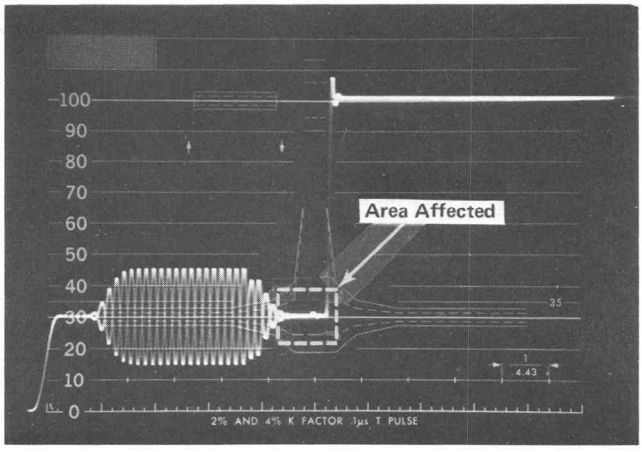
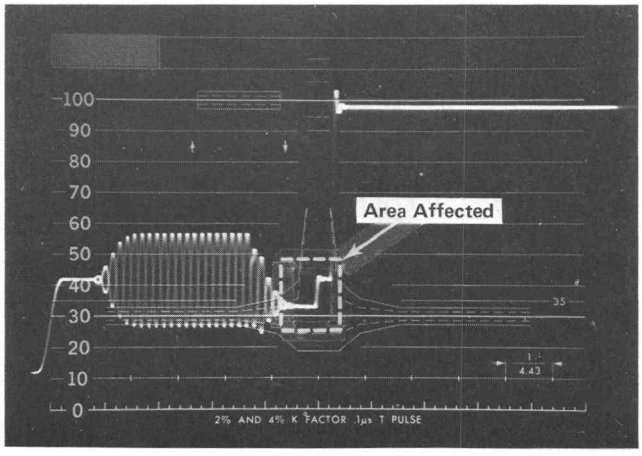


Fig. 4-19. Typical waveform monitor display used to check or adjust auxiliary sync level.



(A) R7361 (Auxiliary Sync Level) properly adjusted.



(B) R7361 (Auxiliary Sync Level) misadjusted.

Fig. 4-20. ITS Insertion adjustment.

c. Switch the INSERTION CONTROL between PROGRAM, PREVIEW, and BYPASS.

CHECK—Blanking level (DC) of the display should not change between any mode. In addition, there should be no amplitude change of the ITS or full-field signals when switching between PROGRAM, PREVIEW, and BYPASS.

ADJUST—R505 (Prog Gain) so that no amplitude change of the insertion signal occurs while switching between PROGRAM and AUXILIARY.

ADJUST—R765 (Prog Lum Gain) so that no amplitude change of the full-field signal occurs while switching between PROGRAM and BYPASS.

d. Step b and c interact; repeat as necessary.

e. Set the FULL FIELD SIG switch to WINDOW. Switch the INSERTION CONTROL between BYPASS and PROGRAM.

CHECK—2T Pulse to Bar; 100% within 0.25% (1.8 mV).

20T Pulse to Bar; 100% within 0.5% (3.5 mV).

20T baseline ripple; should be 0.5% or less (3.5 mV).

3. Check/Adjust PREVIEW MONITOR OUT

a. Note the DC level of the PROGRAM OUTPUT LINE blanking level.

b. Display the PREVIEW OUTPUT signal on the test oscilloscope. Set the INSERTION CONTROL switch to PREVIEW.

CHECK—Preview blanking level (DC) should be within 50 mV of the level noted in part a.

ADJUST—R975 (Pre Sync Level) so that the ITS blanking level matches the preview blanking level.

ADJUST—R985 (Pre DC Level) so that the preview blanking level matches the program blanking level within 50 mV. (0 volts plus any full-field blanking level error.)

c. Change the cable to display the PROGRAM OUTPUT LINE signal on the test oscilloscope. Note the overall amplitude of the signal. Change the cable to display the PREVIEW OUTPUT signal.

CHECK—Preview signal overall amplitude should match the program signal overall amplitude within 1%.

ADJUST—R965 (Pre Gain) to match the preview signal to the program signal.

d. Steps b and c interact; repeat as necessary.

e. Change the cable to display the other PREVIEW OUTPUT signal.

CHECK—Preview signals should be the same amplitude.

4. Check Multiburst Flatness

a. Set the FULL FIELD SIG switch to MULTIBURST. Switch the INSERTION CONTROL between PREVIEW and BYPASS.

CHECK—Tilt on preview multiburst signal (as measured between the first and last burst packets) should match the tilt of the full-field multiburst signal within 1%.

Repeat check for the multiburst signal inserted in the vertical interval.

b. Display the PROGRAM SIGNAL on the test oscilloscope. Switch the INSERTION CONTROL between PROGRAM and BYPASS.

CHECK—Tilt on program multiburst signal should match the tilt of the full-field multiburst signal within 1%.

Repeat check for the multiburst signal inserted in the vertical interval.

5. Check INSERT SUBCARRIER PHASE

a. Connect the video signal source to the PROGRAM INPUT. Display the PROGRAM OUTPUT signal on the vectorscope.

CHECK—INSERT SUBCARRIER PHASE control range is approximately 28°; range should be at least 5° on either side of 60°.

b. Set the INSERT SUBCARRIER PHASE control to set the ITS vectors to 60°. Display the PREVIEW signal on the vectorscope.

CHECK—ITS vectors should be at 60° (no phase error).

6. Check/Adjust Multiburst Flatness, Subcarrier Phase, and Pulse to Bar Ratios

NOTE

Adjustments in Step 6 affect the checks made in Step 2e, Steps 4a and 4b, and Steps 5a and 5b. After making the adjustments, repeat these checks.

a. Disconnect the video signal source from the PROGRAM INPUT. Display the PROGRAM signal on the test oscilloscope.

CHECK—TTL transients should be no more than 5 mV peak-to-peak.

NOTE

If the writing rate of the test oscilloscope is not sufficient to display these transients, do not adjust R780 or C779 at this time, but go to step c.

b. Preset C779 (Prog MB ITS) for minimum capacitance.

ADJUST—R780 (Program Bandwidth) for minimum TTL transients.

c. Connect the FULL FIELD TEST SIGNAL to the PROGRAM INPUT. Set the FULL FIELD SIG switch to MULTIBURST.

ADJUST—C779 (Prog MB ITS) so that the tilt of the full-field multiburst insertion signals are the same in either the PROGRAM or the BYPASS position of the INSERTION CONTROL switch.

ADJUST—C749 (Program Chroma Gain) so that the tilt of the full-field multiburst ITS are the same in ether the PROGRAM or the BYPASS position of the INSERTION CONTROL switch.

d. Set the FULL FIELD SIG switch to WINDOW.

ADJUST—R780 (Program Bandwidth) so that the pulse and bar amplitudes are the same in either the PROGRAM or the BYPASS position of the INSERTION CONTROL switch.

e. Steps c and d interact; repeat as necessary.

f. Check that the following signals are within the listed tolerances as the INSERTION CONTROL is switched between BYPASS and PROGRAM.

CHECK—Program signal to full-field signal as follows:

MB ITS: within 1%

Chroma Gain; within 1%.

2T Pulse to Bar ratio; 100% within 0.25% (1.8 mV).

20T Pulse to Bar ratio; 100% within 0.5% (3.5 mV).

20T baseline ripple change; 0.5% or less (3.5 mV).

g. Connect the Signal Generator through the 50 Ω to 75 Ω Min Loss Atten to the 148 PROGRAM INPUT. Display the PROGRAM OUTPUT on the test oscilloscope. Sync the 148 externally. Set the Signal Generator for 500 mV of 10 MHz as observed with the 148 in the BYPASS mode.

CHECK—Test Oscilloscope display should not change by more than ±1% to 6 MHz and +1%, –6.5% to 10 MHz when the 148 mode is changed to PROGRAM.

7. Check/Adjust INSERT SUBCARRIER PHASE

a. Connect the video signal source to the PROGRAM INPUT. Set the SYNC SOURCE switch to INT. Display the PROGRAM SIGNAL on the vectorscope.

CHECK—INSERT SUBCARRIER PHASE control range is approximately 28°; range is at least 5° on either side of 60°.

ADJUST—L5100 (ITS Phase) so that the INSERT SUBCARRIER PHASE control range is at least 5° on either side of 60°.

b. Rotate the INSERT SUBCARRIER PHASE control to set the ITS vector to 60°.

c. Display the PREVIEW OUTPUT signal on the vectorscope.

CHECK—ITS vector should be at 60°.

ADJUST—C849 (Preview Flatness) to set the ITS vector to 60°.

8. Check/Adjust PREVIEW OUTPUT

a. Set the SYNC SOURCE switch to EXT. Connect the rear-panel FULL FIELD TEST SIGNAL to the PROGRAM LINE IN.

b. Display the PREVIEW OUTPUT signal on the monitor and vectorscope. Set the FULL FIELD SIG switch to MULTIBURST.

CHECK—Tilt of the full-field multiburst insertion test signals are within 1% in either the PREVIEW or the BYPASS position of the INSERTION CONTROL switch.

ADJUST—C879 (Pre MB ITS) so that the tilt of the full-field multiburst insertion test signals are within 1% in either the PREVIEW or the BYPASS position of the INSERTION CONTROL switch.

CHECK—Tilt of the full-field multiburst signals are within 1% in either the PREVIEW or the BYPASS position of the INSERTION CONTROL switch.

9. Check/Adjust Unity Gain

a. Display the FULL FIELD TEST SIGNAL OUT on the test oscilloscope. Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to 100.

b. Connect the chopper to the test oscilloscope. Differentially display the chopped signal. Determine, then note the peak-to-peak amplitude of the FLAT FIELD test signal.

c. Connect the FULL FIELD TEST SIGNAL to the PROGRAM INPUT. Connect the PROGRAM OUTPUT to the test oscilloscope.

CHECK—PROGRAM OUTPUT signal amplitude should be within 1% of that noted in part b.

ADJUST—R765 (Prog Lum Gain) so that the PROGRAM OUTPUT signal amplitude is the same as noted in part b.

d. Connect the PREVIEW OUTPUT to the test oscilloscope.

CHECK—PREVIEW OUTPUT signal amplitude should be within 1% of that noted in part b.

ADJUST—R965 (Pre Lum Gain) so that the PREVIEW OUTPUT signal amplitude is the same as noted in part b.

10. Check Waveform Tilt, Program, and Preview

a. Connect the FULL FIELD TEST SIGNAL to the test oscilloscope. Connect the FULL FIELD TEST SIGNAL OUT to the test oscilloscope. Set the FULL FIELD SIG switch to WINDOW. Obtain a differential display and note any tilt (low frequency slope) of the 25 μs bar.

b. Connect the FULL FIELD TEST SIGNAL to the PROGRAM INPUT. Connect the PROGRAM OUTPUT to the test oscilloscope.

CHECK—Tilt should be within 0.5% of that noted in part a (3.6 mV or less).

c. Connect the PREVIEW OUTPUT to the test oscilloscope.

CHECK—Tilt should be within 0.5% of that noted in part a (3.6 mV or less).

d. Connect the FULL FIELD TEST SIGNAL to the test oscilloscope. Set the FULL FIELD SIG switch to FIELD SQ WAVE. Obtain a differential display of the field square-wave signal and note any tilt error.

e. Connect the rear-panel FULL FIELD TEST SIGNAL to the PROGRAM INPUT. Connect the PROGRAM OUTPUT to the test oscilloscope.

CHECK—Tilt change should be 3.6 mV or less (0.5%).

f. Connect the PREVIEW OUTPUT to the test oscilloscope.

CHECK—Tilt change should be 3.6 mV or less (0.5%), referenced to the full-field signal.

11. Check AUXILIARY PEDESTAL

a. Display the PREVIEW OUTPUT signal on the monitor. Set the INSERTION CONTROL switch to AUXILIARY.

CHECK—AUXILIARY PEDESTAL control range should be from ⩾ 70 mV to ⩾ 630 mV.

b. Connect a 0.1 to 0.5 V signal to the AUX IN input (the video signal source subcarrier signal via a X10 attenuator is acceptable).

CHECK—External signal rides on the auxiliary pedestal; it should not affect sync or ITS.

12. Check UNITY GAIN/VAR & LEVEL

Set the INSERTION CONTROL switch to PROGRAM. Set the UNITY GAIN/VAR switch to VAR. Display the PROGRAM OUTPUT signal on the monitor.

CHECK—LEVEL control range should be from 70% (or less) to 140% (or more).

13. Check PROGRAM OUTPUT Aberrations

a. Disconnect the video signal source from the PROGRAM INPUT. Externally sync the 148 with Burst Flag, PAL Pulse, Subcarrier, and Comp Sync from the video signal source. Connect the PROGRAM OUTPUT to the test oscilloscope.

CHECK—Residual subcarrier should be –60 dB (0.7 mV) or less, on lines 11 through 16 and lines 20, 21, and 22.

b. Connect a 5 MHz Low Pass Filter in series with the PROGRAM OUTPUT signal.

CHECK—All blanking lines and inactive parts of lines. Except for the Insertion Test Signals on lines 17, 330; 18, 331; and 19 there should be no signal greater than –40 dB (7.0 mV).

c. CHECK—Active parts of lines for spurious signals, should be no greater than –60 dB (0.7 mV).

d. CHECK—Crosstalk. Rotate the FULL FIELD SIG switch. Signal change (crosstalk) should not exceed:

–70 dB (0.22 mV) for 2T Pulse,

–60 dB (0.7 mV) for subcarrier (LINE 331),

–60 dB (0.7 mV) for all other Full Field signals.

e. Connect a 5 MHz Weighting Network in series with the PROGRAM OUTPUT and the 5 MHz Low Pass Filter.

CHECK—Hum and power line related transients, should be no greater than –60 dB (0.7 mV).

f. Connect a 75 Ω termination to the PROGRAM INPUT. Connect the PROGRAM OUTPUT through a 5 MHz Weighting Network, 5 MHz Low Pass Filter and 75 Ω termination to the RMS Voltmeter.

CHECK—Random noise output, should be no greater than −75 dB (0.14 mV).

g. Connect an external composite video signal which contains a Sin^2 Pulse and Bar inserted between lines 11 and 22 of the vertical interval. Remove the two diode jumpers from the off line, all field selection jumpers, and the line 16 option (P4400). Add diode jumpers to both field selector rows.

CHECK—Incoming ITS should be deleted as follows:

2T Pulse	−70 dB
Subcarrier	−60 dB

GROUP 14-TIMING

1. Check INSERT DELAY Range

a. Display the FULL FIELD TEST SIGNAL on the test oscilloscope. Select a reference point on the signal and vary the INSERT DELAY control.

CHECK—Range of control should be greater than 1 μs.

b. Leave the control at electrical center.

2. Check/Adjust Pulse Width

Observe the sync pulse.

CHECK—Timing accuracy as given below.

Fig. 4-21	Component	Timing
A	serration width	4.5 to 4.9 μs
B	sync width	4.5 to 4.9 μs
C	equalizer width	2.34 to 2.36 μs

ADJUST—Timing accuracy as given below.

Fig. 4-22	Timing
R356 (Serration Width)	4.7 μs
R351 (Sync Width)	4.7 μs
R251 (Equalizer Width)	2.35 μs

3. Check/Adjust Sync Delay

a. Display the vertical interval of the PROGRAM OUTPUT signal on the test oscilloscope. INSERT DELAY control should be at electrical center. Observe the insertion signal sync pulse of noise, multiburst, or colour bar.

CHECK—Timing, as shown in Fig. 4-21D, should be 12 μs within 50 ns.

ADJUST—R1978 (Sync Delay), see Fig. 4-22, for 12 μs.

4. Check LINE RATE ONLY Switch

a. Display the vertical interval of the FULL FIELD TEST SIGNAL on the waveform monitor. Set the INSERTION CONTROL switch to PREVIEW and LINE RATE ONLY.

CHECK—Field Sync and blanking should have been removed.

b. Check Bypass Relay
Set the 148 POWER switch to OFF.

CHECK—Test oscilloscope display should be the video signal source with no ITS inserted.

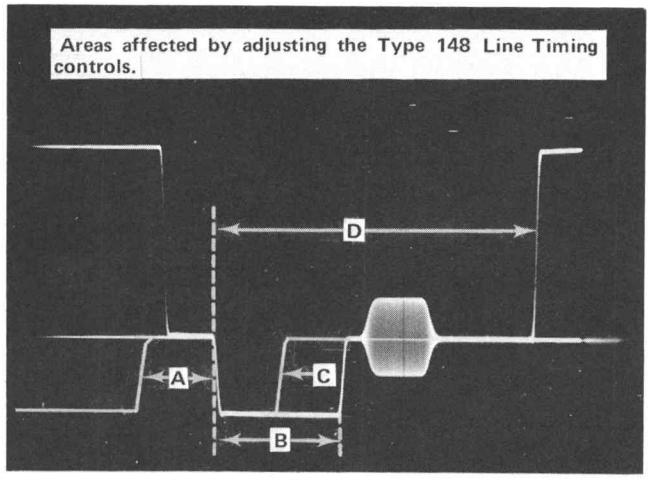


Fig. 4-21. Areas affected by timing adjustments.

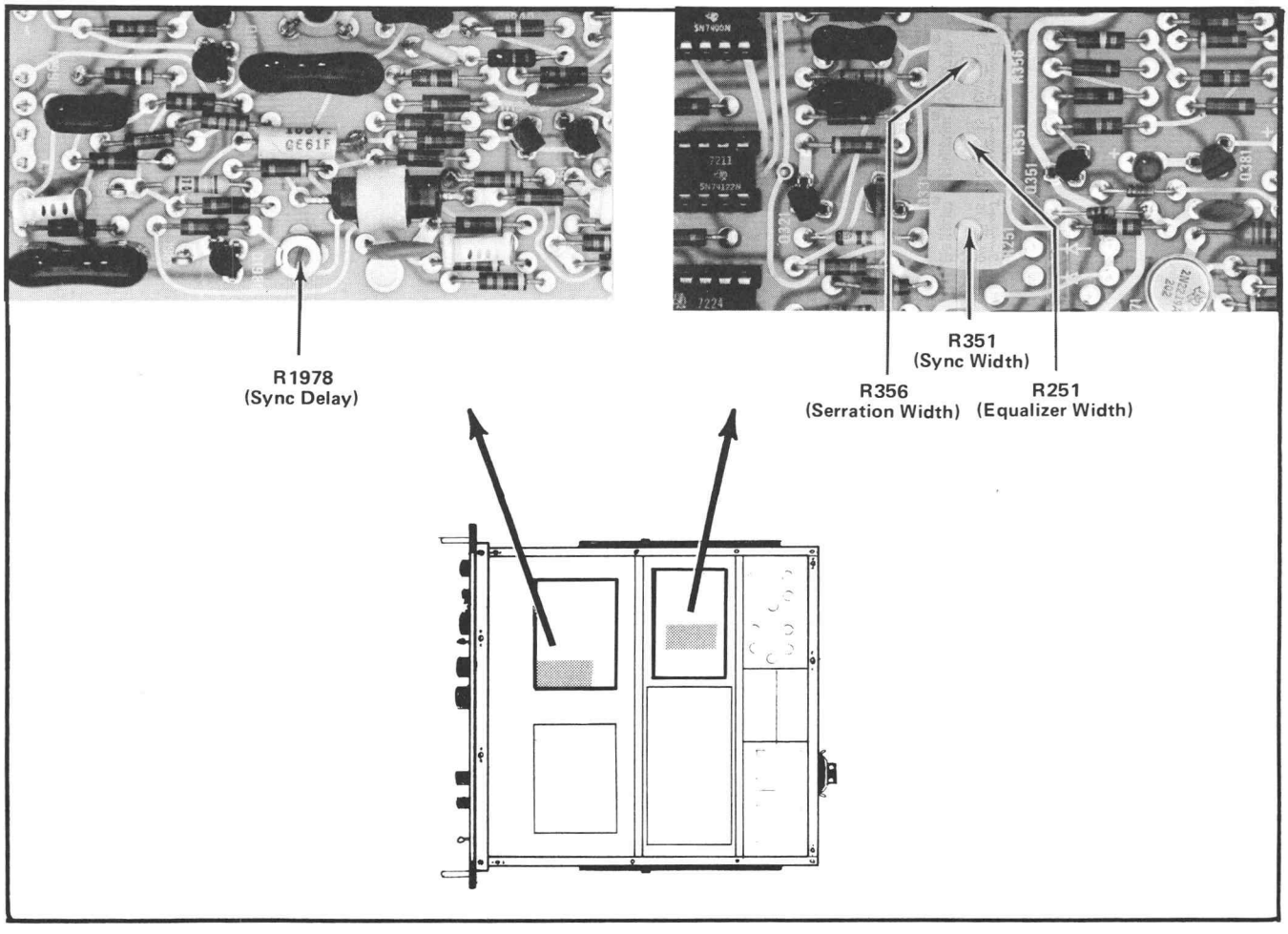


Fig. 4-22. Timing adjustment location.

5. Check ALT and ALT & 6 LINES FLAT FIELD Operation

a. Display a field of 148 FULL FIELD signal, magnified 10 times. Set the ALL LINES, ALT, ALT & 6 LINES FLAT FIELD switch to ALT.

Display should be the signal selected by the right FULL FIELD SIG switch followed by that selected by the left FULL FIELD SIG switch alternately for the entire field.

b. Set the ALL LINES, ALT, ALT and 6 LINES FLAT FIELD switch to ALT & 6 LINES FLAT FIELD.

CHECK–Display should be the signal selected by the right FULL FIELD SIG switch followed by the signal selected by the left FULL FIELD SIG switch, followed by 6 lines of flat field for the entire field.

Return the ALL LINES, ALT, ALT & 6 LINES FLAT FIELD switch to ALL LINES.

GROUP 15-OPTIONAL CHECKS

This group of checks has been performed at the factory and may not be desired by the user.

1. POWER SUPPLY REGULATION

Requires a variable autotransformer.

Repeat the checks given in GROUP 1, Steps 1 and 2, while varying the autotransformer over the line voltage range listed for the LINE VOLTS selector switch position being used.

2. ERASE

Switch to AUX and verify the video signal source puts ITS on lines 11 through 22, both fields.

Remove the 2 diode jumpers from the OFF line. Remove all field selection jumpers and the line 16 option (P4400).

Add a diode jumper (cathode inboard) to both fields and check for erase on both fields, lines 11 through 22. Check line for signal attenuation in ERASE mode, active line area. Use 5 MHz LOW PASS FILTER.

Move jumper to F2, F4 and check for erase on F2, F4, but not F1, F3. Repeat for F1, F3; but not F2, F4.

Check that OFF does not erase.

3. RETURN LOSS

Requires a return loss bridge, constant amplitude signal generator and a minimum loss attenuator. See Test Equipment Used list, item 15. This is to be used in conjunction with the return loss bridge instruction manual.

a. Connect the sync signal from the video signal source to their respective inputs. Set the SYNC SOURCE switch to EXT. Externally trigger the test oscilloscope from composite sync.

b. Connect the return loss bridge to the test oscilloscope (both arms terminated).

c. Balance the bridge.

d. Connect the return loss bridge unknown arm to the 148 PROGRAM INPUT.

e. Check INPUT return loss with the POWER switch OFF and the PROGRAM OUTPUT connector terminated with the return loss bridge termination.

CHECK—Return Loss should be at least −30 dB (16 mV) from 50 kHz to 7 MHz.

f. Turn the POWER switch ON.

CHECK—INPUT return loss should be at least −30 dB (16 mV) from 50 kHz to 7 MHz.

CHECK—Return loss as follows:

PROGRAM OUTPUT LINE	−30 dB to 7 MHz (≤16 mV)
PROGRAM MONITOR	−30 dB to 7 MHz (≤16 mV)
PREVIEW OUTPUT (both)	−30 dB to 7 MHz (≤16 mV)
FULL FIELD OUT (rear)	−34 dB to 7 MHz (≤10 mV)
COMPOSITE SYNC	−30 dB to 3.6 MHz (≤16 mV)
EXT ITS INPUT	−30 dB to 5 MHz (≤16 mV)
AUX IN	−30 dB to 7 MHz (≤16 mV)
NOISE OUT (LEVEL-off)	−30 dB to 5 MHz (≤16 mV)
FULL FIELD OUT (front)	−34 dB to 7 MHz (≤10 mV)
BURST FLAG	−30 dB to 5 MHz (≤16 mV)
PAL PULSE	−30 dB to 5 MHz (≤16 mV)
MIXED SYNCS	−30 dB to 5 MHz (≤16 mV)
SUBCARRIER	−30 dB to 5 MHz (≤16 mV)

4. EXT ITS GAIN

Requires the video signal source ITS amplitude be set to the full-field amplitude or the difference between the two noted. The ITS Insertion board must be programmed to insert an external ITS.

Connect the rear-panel FULL FIELD SIGNAL to the PROGRAM INPUT. Connect the video signal source comp video to the EXT ITS IN. Connect the video signal source signals required for external sync to the 148. Set the SYNC switch to EXT. Set the signal to insert a modulated staircase ITS on line 17, field 1 and program the 148 for it. Display the ITS area of the PROGRAM OUTPUT signal on the monitor.

Adjust R7993 (Ext ITS Gain), see Fig. 4-19, to match the external ITS amplitude to the COLOUR BAR ITS amplitude.

Display the PROGRAM OUTPUT signal on the vectorscope. Set the vectorscope to measure differential gain, then differential phase on line 17, field 1, 3.

Check Ext ITS amplifier diff gain $\leqslant$ 0.2%, and diff phase $\leqslant 0.15^{\circ}$.

5. SPECTRUM ANALYSIS

Requires a spectrum analyzer. The spectrum analyzer may be used with an independent monitor or the test oscilloscope. When adjusting several parameters at the same time the advantage is with the independent monitor. The test oscilloscope requires several setup changes when switching from real time and amplitude measurements to spectrum analysis.

Refer to the spectrum analyzer instruction manual for setup information.

Harmonics. All full-field signals have a harmonic content requirement of –40 dB or greater.

Noise Spectrum. The noise spectrum should be flat within 6 dB to 5 MHz.

SECTION 5
RACKMOUNTING

RACKMOUNTING INSTRUCTIONS

Mounting Methods (Figs. 5-1, 5-2, 5-5 and 5-6)

The instruments will fit most commercial consoles and most 19-inch wide racks whose front and rear rail holes conform to Universal, EIA, RETMA and Western Electric hole spacing.

Fig. 5-1 shows the instrument installed in a cabinet type rack with 1 3/4-inch wide slide-out tracks for a non-tilt installation. The instrument is secured into the rack by means of four captive thumb screws. When the thumb screws on the front panel are loosened, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 5-2). This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack.

The slide-out tracks easily mount to the cabinet rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10 1/2 to 24 1/2 inches. Some means of support (for example, make extensions for the rear mounting brackets) is needed for the rear ends of the slide-out tracks if the tracks are going to be installed in a cabinet rack whose inside dimension between front and rear rails is not the proper distance (10 1/2 inches to 24 1/2 inches).

Instrument Dimension

The last page in this section shows dimensional drawings exclusive of the power cord and cables.

Width—A standard 19-inch rack may be used. The dimension or opening between the front rails must be at least 17 5/8 inches (see Fig. 5-2) for a cabinet rack in which the front lip of the stationary section is mounted behind an untapped front rail as shown in the right-hand illustration of Fig. 5-6. This dimension allows room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

Depth—For proper circulation of cooling air, allow at least 2 inches clearance behind the rear of the instrument and any enclosure on the rack (see dimensional drawing). If it is sometimes necessary or desirable to operate the generator in the fully extended position, use cables that are long enough to reach from the instrument to the location where the signal(s) is to be applied.

Rackmounting in a Cabinet Rack

General Information—The slide-out-tracks for the instrument consists of two assemblies, one for the left side of the instrument and one for the right side. Each assembly consists of three sections as illustrated in Fig. 5-3. The stationary section attaches to the front and rear rails of the rack with inside dimensions as indicated in Fig. 5-2; the chassis section attaches to the instrument and is installed at the factory; the intermediate section fits between the other two sections to allow the instrument to be fully extended out of the rack.

The small hardware components included with the slide-out track assemblies are shown in Fig. 5-4. The hardward shown in Fig. 5-4 is used to mount the slide-out tracks to the rack rails having this compatibility.

(a) Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting holes (see Fig. 5-6).

(b) Front rail holes may have already been countersunk prior to this installation.

Because of the compatibility given in (b), there will be some screws left over.

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets for both sides including hardware are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop are located near the top of the matched sets when they are properly mated to the chassis sections as shown in Fig. 5-3.

Mounting Procedure—Use the following procedure to mount both sets. See Fig. 5-5 and 5-6 for installation details.

1. To mount the instrument directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 5-5 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front rails are not countersunk, use the pan head screws and bar nuts to mount the stationary sections similar to the right-hand illustration shown in Fig. 5-6.

(b) If the front rails are countersunk, use the flat head screws and bar nuts to mount the stationary sections as shown in Fig. 5-6 right-hand illustration.

3. Mount the stationary slide-out track sections to the non-tapped rear rails using this method:

Mount the left stationary section with hardware provided as shown in the left-hand or center illustration in Fig. 5-6. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 5-6 as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

Adjustments

To adjust the slide-out tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as described and as shown in steps 1 through 4 of Fig. 5-7 installation procedure.

2. Adjust the slide-out tracks for proper spacing as shown in Fig. 5-8.

Maintenance

The slide-out tracks require no lubrication. The special dark gray finish on the sliding parts is a permanent lubrication.

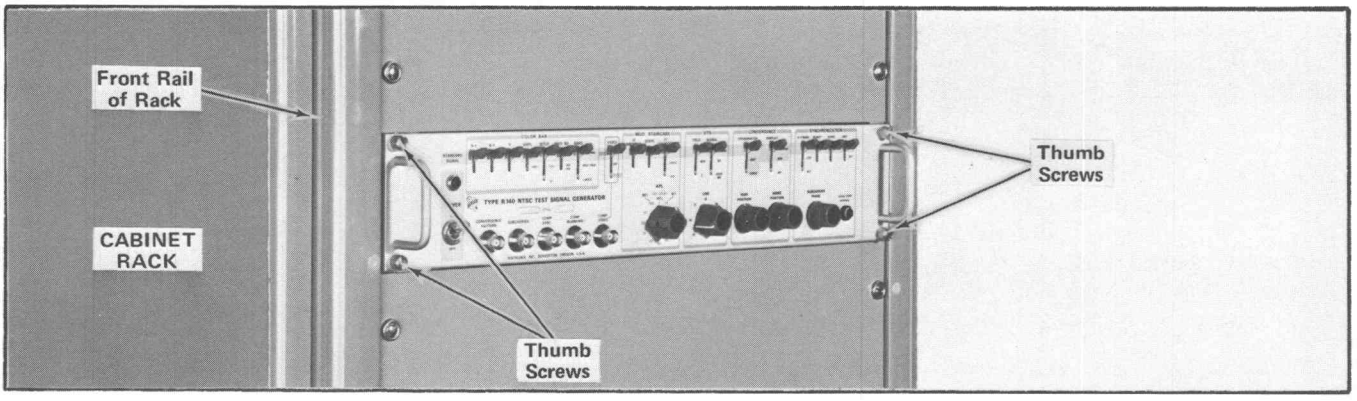


Fig. 5-1. The generator installed in a cabinet rack.

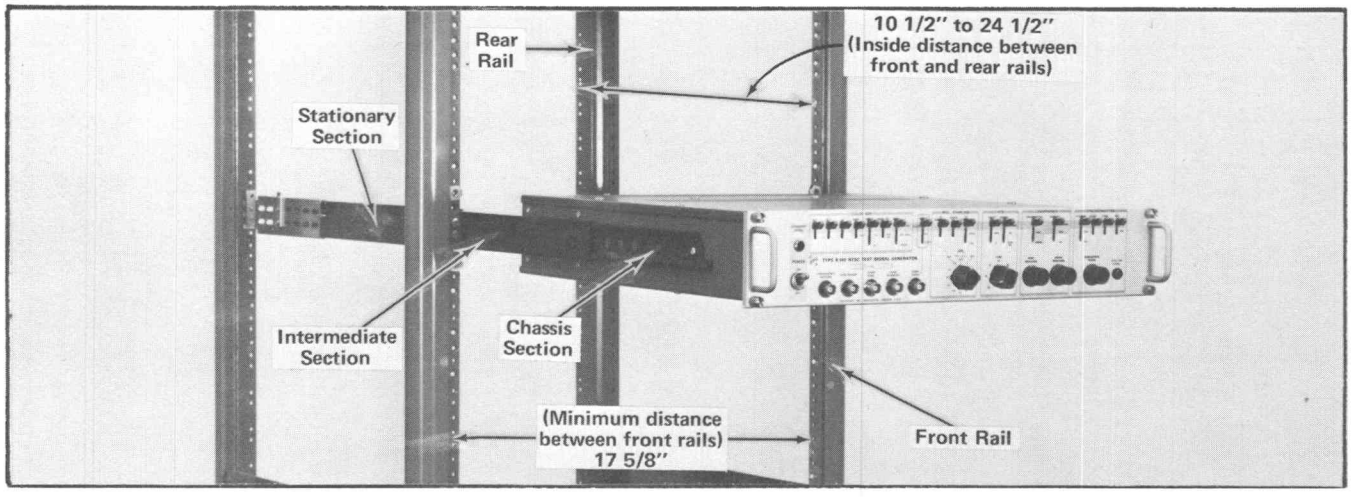


Fig. 5-2. The generator shown in the fully extended position. The cabinet rack sides have been removed from the rack to show mounting.

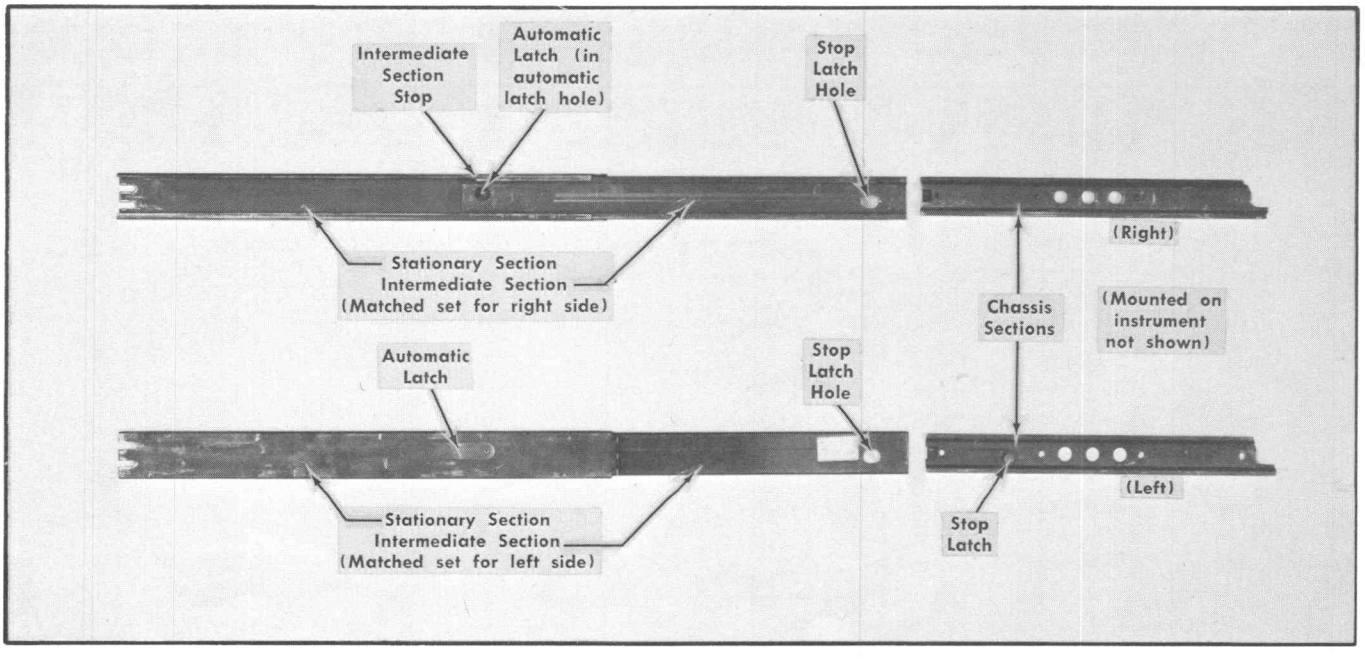


Fig. 5-3. Illustration showing the 1 3/4-inch wide slide-out track assemblies.

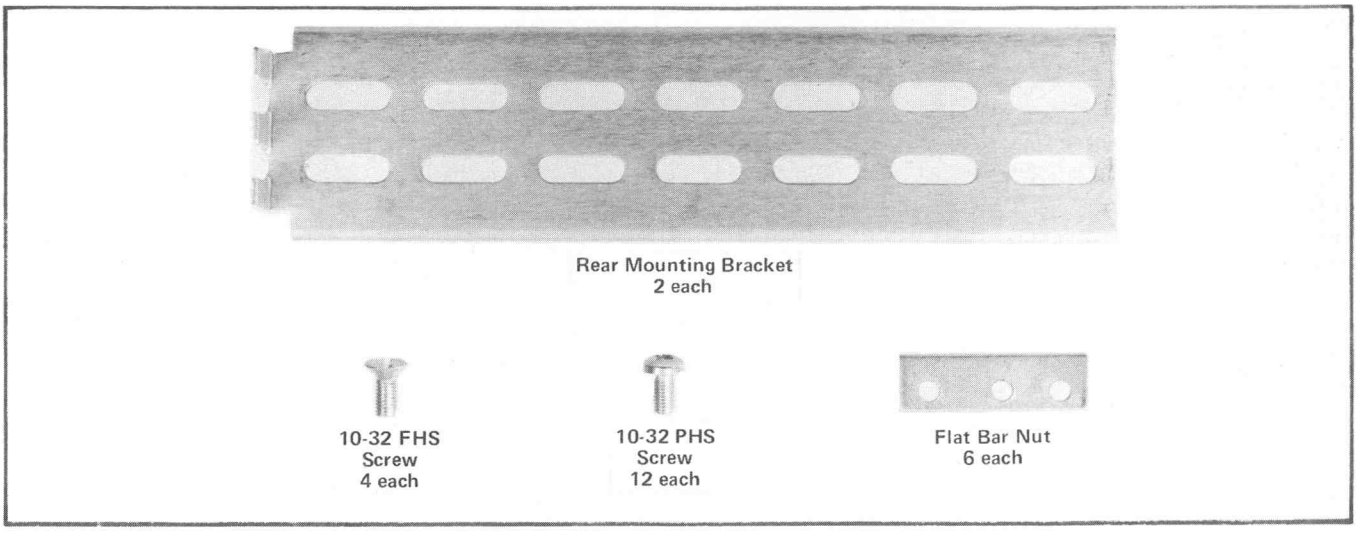


Fig. 5-4. Small hardware components for mounting the stationary sections to the rack rails.

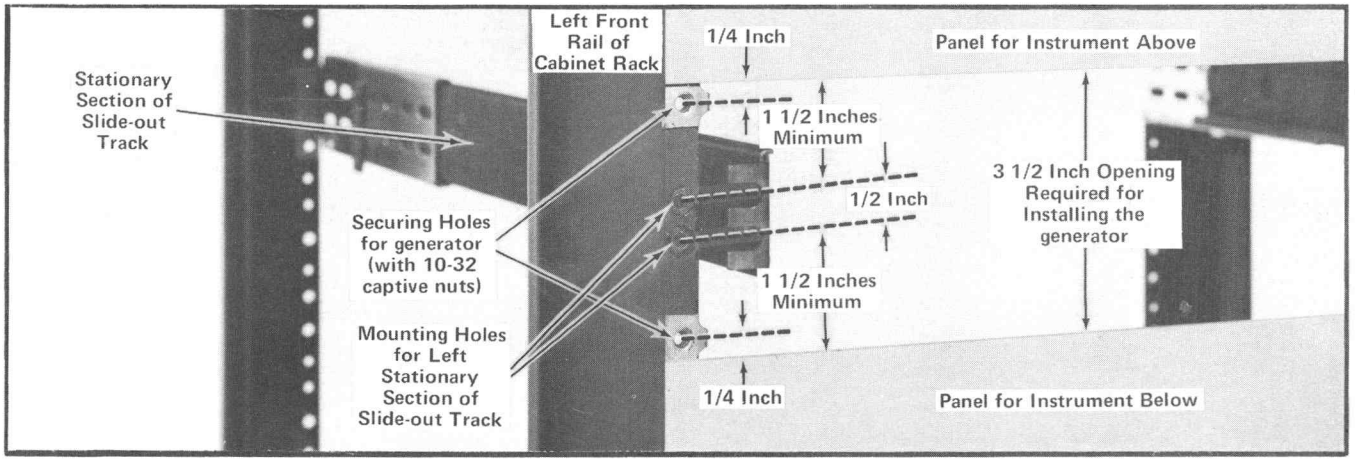


Fig. 5-5. Vertical mounting position of the left stationary section and location of the securing holes. These same dimensions apply to the right front rail.

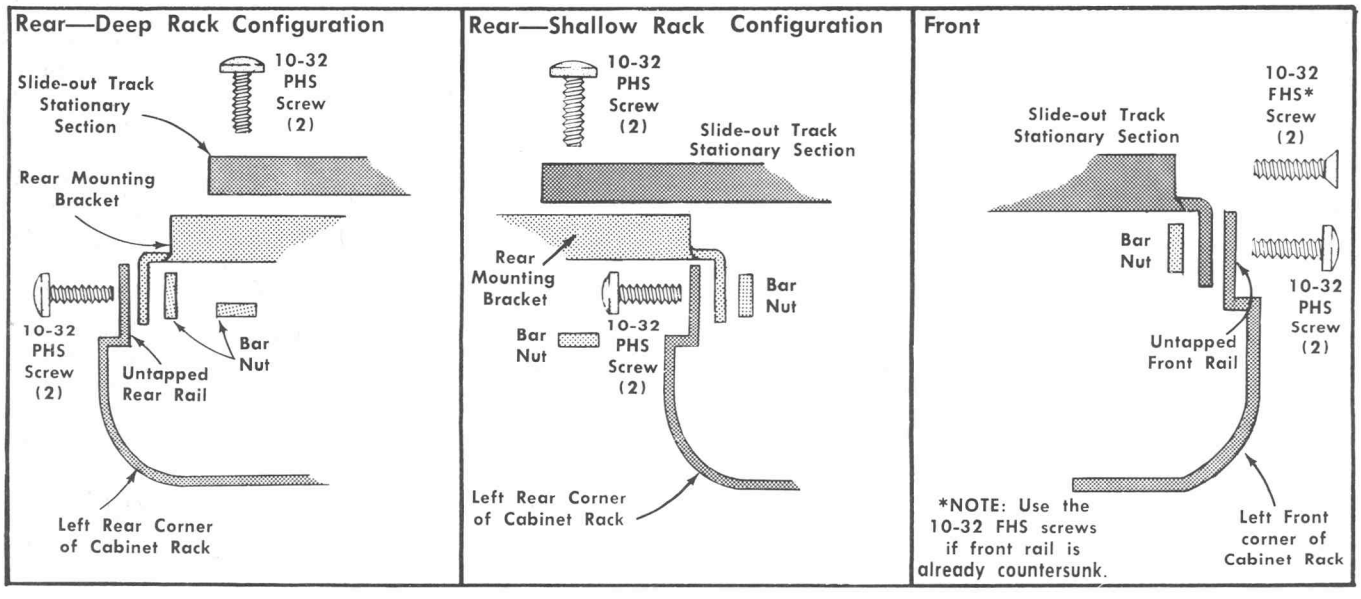


Fig. 5-6. Top view of cabinet rack showing mounting position of the left stationary section to the rails of the rack. Since the rails are not tapped, bar nuts are used to mount the stationary section to the rack rails.

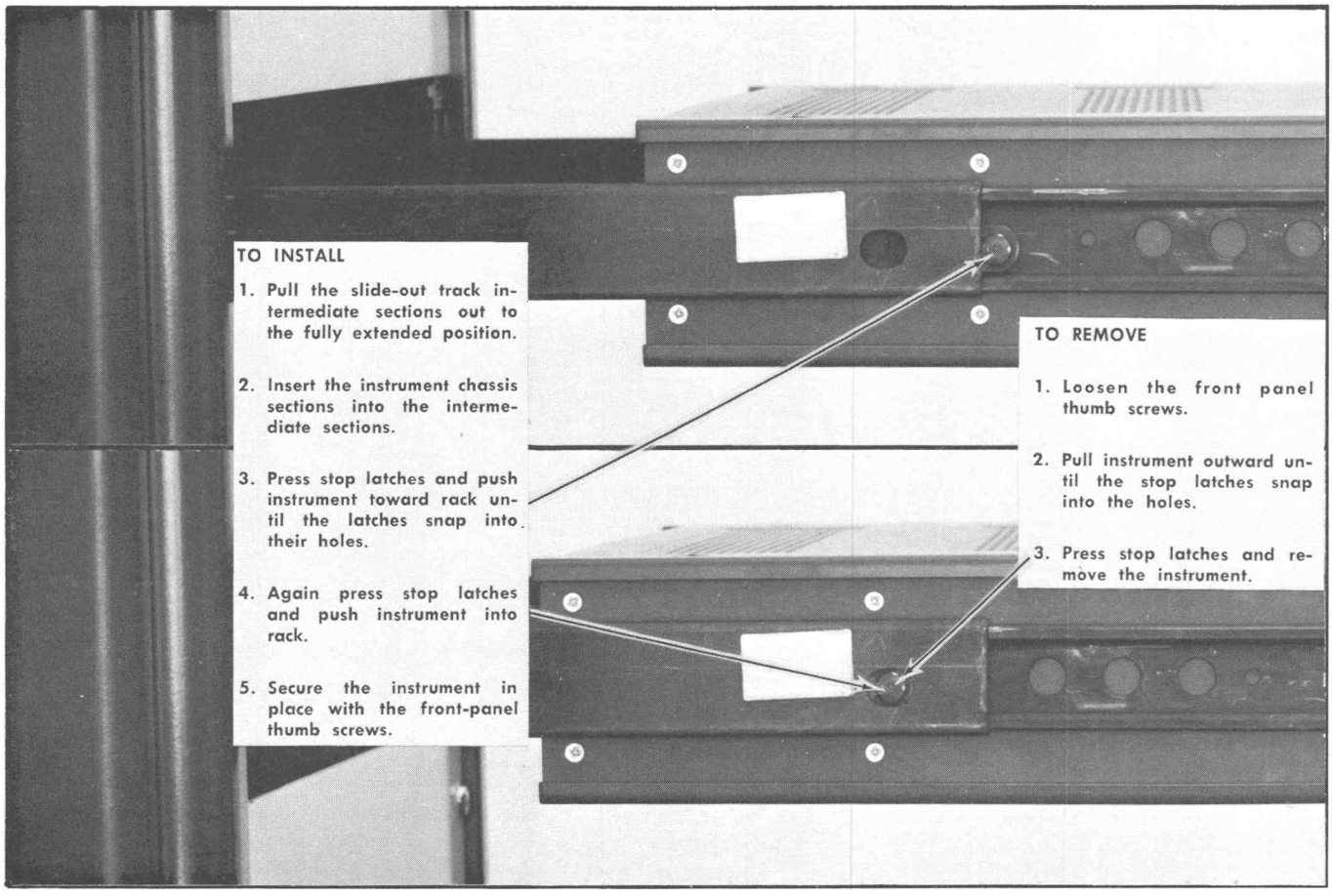


Fig. 5-7. Installing and removing the instrument.

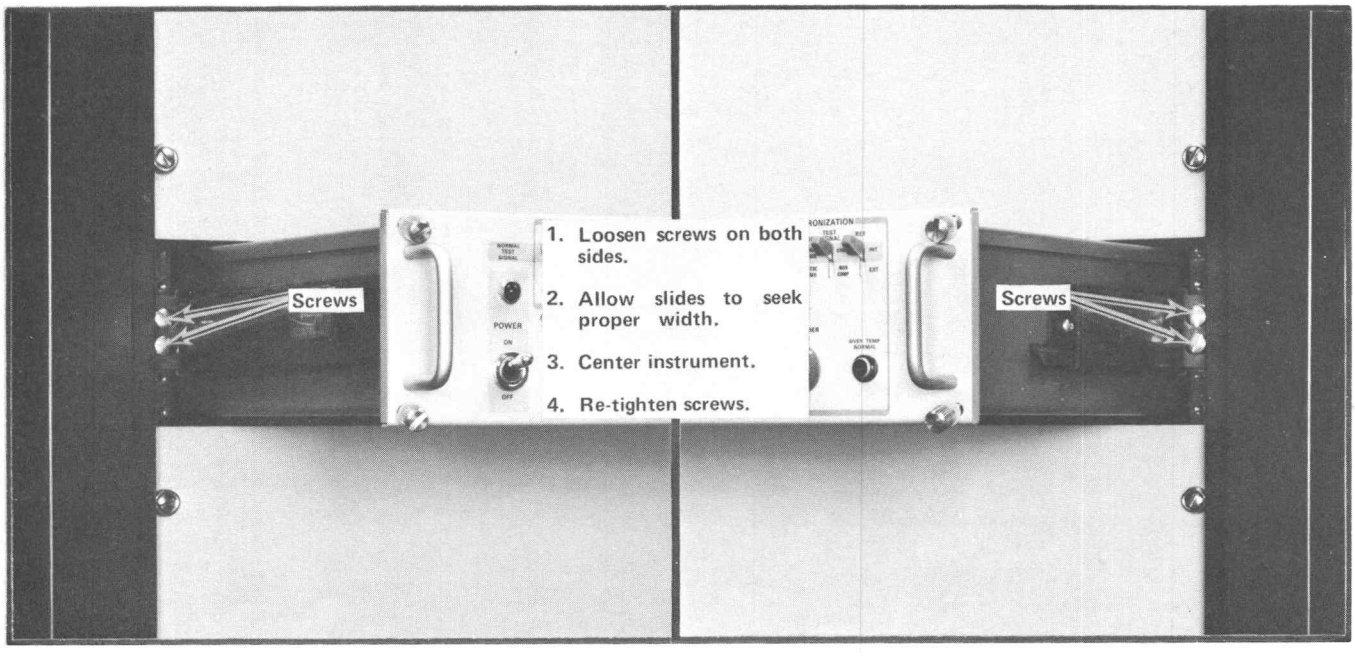
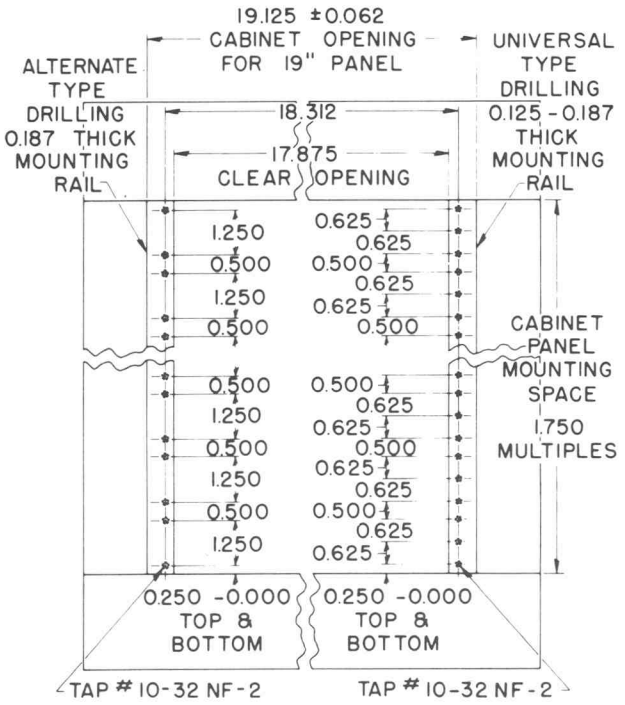
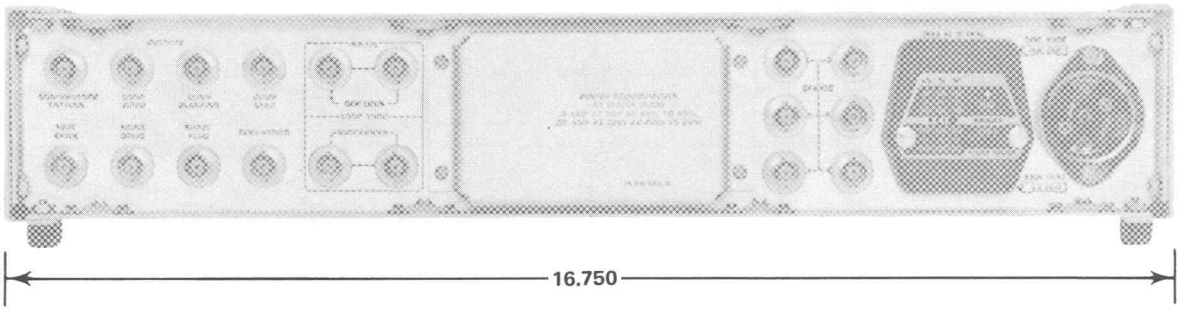
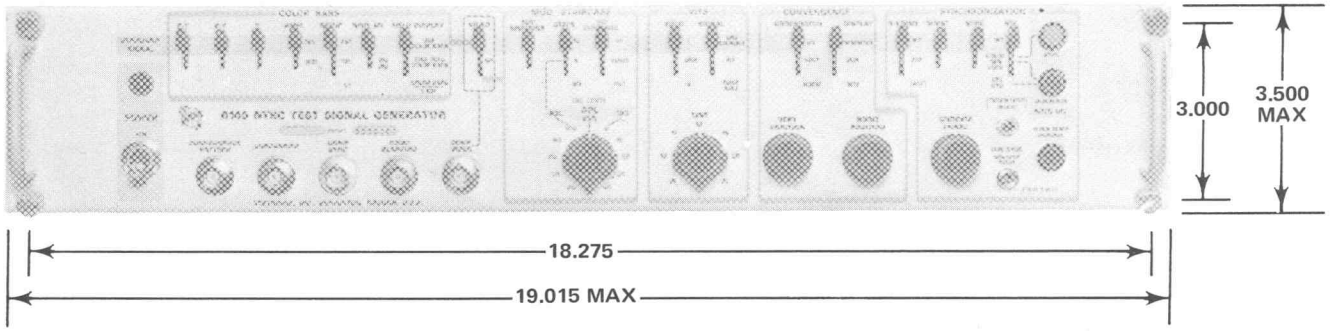


Fig. 5-8. Adjusting the slide-out tracks for smooth sliding action.

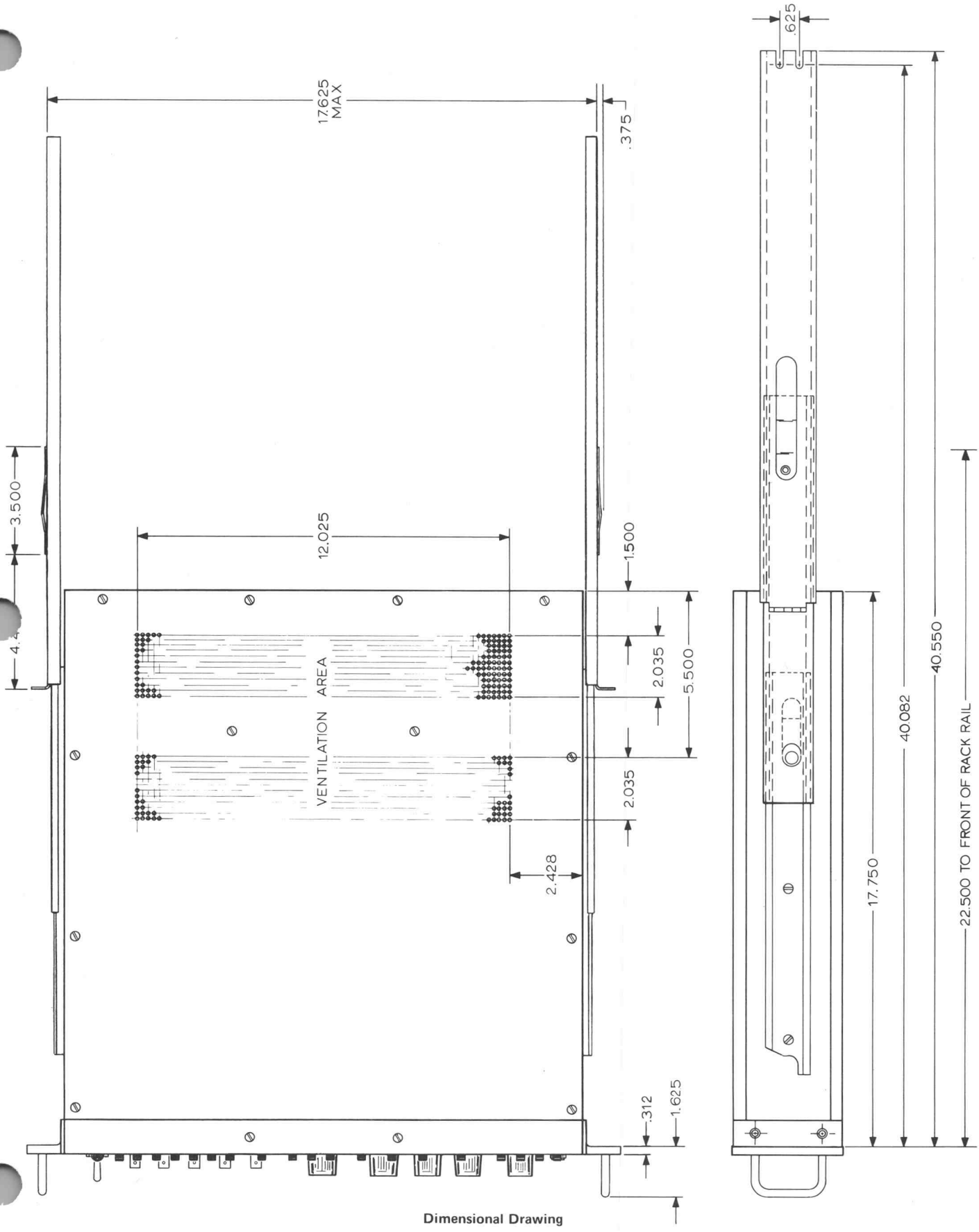
RACK RAIL TYPES







Dimensional Drawing



Dimensional Drawing

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94043
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
78277	SIGMA INSTRUMENTS INC.	170 PEARL STREET	SOUTH BRAINTREE, MA 02185
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80740	BECKMAN INSTRUMENTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
95348	GORDOS CORPORATION	250 GLENWOOD AVENUE	BLOOMFIELD, NJ 07003

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A0	670-1468-02	B010100	B069999	CKT BOARD ASSY:VIT INSERTION	80009	670-1468-02
A0	670-1468-03	B070000		CKT BOARD ASSY:VIT INSERTION	80009	670-1468-03
A1	670-1916-00			CKT BOARD ASSY:VERT COUNTER	80009	670-1916-00
A2	670-2040-00	B010100	B029999	CKT BOARD ASSY:HORIZONTAL TIMING	80009	670-2040-00
A2	670-2040-02	B030000		CKT BOARD ASSY:HORIZONTAL TIMING	80009	670-2040-02
A3	670-2041-00			CKT BOARD ASSY:APL STAIRCASE NOISE	80009	670-2041-00
A4	670-1919-00			CKT BOARD ASSY:VIT AND FULL FIELD	80009	670-1919-00
A5	670-1918-00			CKT BOARD ASSY:GENLOCK	80009	670-1918-00
A6	670-2039-00			CKT BOARD ASSY:FUNCTION GEN	80009	670-2039-00
A7	670-2042-00			CKT BOARD ASSY:OUTPUT AMPL	80009	670-2042-00
A8	670-1915-00	B010100	B049999	CKT BOARD ASSY:MODULATOR	80009	670-1915-00
A8	670-1915-01	B050000	B059999	CKT BOARD ASSY:MODULATOR	80009	670-1915-01
A8	670-1915-05	B060000		CKT BOARD ASSY:MODULATOR	80009	670-1915-05
A9	670-1917-00	B010100	B071019	CKT BOARD ASSY:SUBCARRIER AND SYNC	80009	670-1917-00
A9	670-1917-05	B071020		CKT BOARD ASSY:SUBCARRIER AND SYNC	80009	670-1917-05
A10	670-2328-00			CKT BOARD ASSY:I.D. CODE	80009	670-2328-00
A11	670-2326-00	B010100	B071139	CKT BOARD ASSY:EXTERNAL DRIVE	80009	670-2326-00
A11	670-2326-04	B071140		CKT BOARD ASSY:EXTERNAL DRIVE	80009	670-2326-04
A12	670-1473-02	B010100	B071019	CKT BOARD ASSY:POWER SUPPLY	80009	670-1473-02
A12	670-1473-07	B071020		CKT BOARD ASSY:POWER SUPPLY	80009	670-1473-07
A13	670-2327-00			CKT BOARD ASSY:RELAY	80009	670-2327-00
A14	670-1927-00			CKT BOARD ASSY:20 T FILTER	80009	670-1927-00
C18	290-0512-00	B010100	B060669	CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C18	290-0745-00	B060670		CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
C24	283-0602-00			CAP.,FXD,MICA D:53PF,5%,300V	00853	D153E530J0
C28	283-0108-00			CAP.,FXD,CER DI:220PF,10%,200V	56289	272C13
C32	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C46	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
C55	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C60	290-0527-00	B010100	B029999	CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C60	290-0528-00	B030000		CAP.,FXD,ELCTLT:15UF,20%,50V	90201	TDC156M050WLC
C76	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8131N075C223K
C84	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C130	290-0512-00	B010100	B060669	CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C130	290-0745-00	B060670		CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
C160	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C194	283-0641-00	B010100	B059999	CAP.,FXD,MICA D:180PF,1%,100V	00853	D151E181F0
C194	283-0631-00	B060000		CAP.,FXD,MICA D:95PF,1%,100V	00853	D151E950F0
C196	283-0641-00	B010100	B059999	CAP.,FXD,MICA D:180PF,1%,100V	00853	D151E181F0
C196	283-0631-00	B060000		CAP.,FXD,MICA D:95PF,1%,100V	00853	D151E950F0
C198	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8131N075C223K
C201	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C278	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C290	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C299	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C335	283-0594-00	B010100	B029999X	CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C337	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C374	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C407	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C413	283-0671-00			CAP.,FXD,MICA D:164PF,1%,500V	72136	D155F1640F0
C415	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C417	283-0154-00			CAP.,FXD,CER DI:22PF,5%,50V	72982	8111B061C0G220J

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C434	283-0646-00			CAP.,FXD,MICA D:170PF,1%,100V	00853	D151E171F0
C436	283-0651-00			CAP.,FXD,MICA D:430PF,1%,500V	00853	D155F431F0
C438	281-0523-00	XB030000	B049999	CAP.,FXD,CER DI:100PF,(NOM VALUE),SEL	72982	301-000U2M0101M
C438	281-0523-00	B050000		CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C454	283-0651-00			CAP.,FXD,MICA D:430PF,1%,500V	00853	D155F431F0
C456	283-0604-00			CAP.,FXD,MICA D:304PF,2%,300V	00853	D153F3040G0
C458	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C474	283-0622-00			CAP.,FXD,MICA D:450PF,1%,300V	00853	D153F451F0
C476	283-0620-00			CAP.,FXD,MICA D:470PF,1%,300V	00853	D153F471F0
C484	283-0626-00			CAP.,FXD,MICA D:1800PF,5%,500V	00853	D195E182J0
C485	283-0669-00	B010100	B049999	CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C485	283-0628-00	B050000		CAP.,FXD,MICA D:410PF,1%,500V	00853	D155F411F0
C487	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C494	283-0108-00			CAP.,FXD,CER DI:220PF,10%,200V	56289	272C13
C513	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C514	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N080651475M
C520	290-0367-00			CAP.,FXD,ELCTLT:70UF,20%,6V NONPOLARIZED	56289	30D1802
C537	281-0659-00			CAP.,FXD,CER DI:4.3PF,+/-0.25PF,500V	72982	301-000C0H0439C
C558	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100DC
C565	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z
C580	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C593	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C595	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C596	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C598	283-0660-00	XB010161		CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
C610	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N080651475M
C614	290-0519-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020MA3
C620	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	72982	861-518B271J
C628	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C650	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C692	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C693	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C694	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C695	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C696	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C718	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C748	281-0645-00	XB030000		CAP.,FXD,CER DI:8.2PF,+/-0.25PF,500V	72982	374-011C0H0829C
C749	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C779	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C790	290-0526-00			CAP.,FXD,ELCTLT:6.8UF,20%,6V	90201	TDC685M006EL
C804	285-0684-00			CAP.,FXD,PLSTC:0.056UF,5%,100V	56289	410P106
C822	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C844	283-0134-00			CAP.,FXD,CER DI:0.47UF,+80-20%,50V	72982	8141N078E474Z
C849	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C865	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C879	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C898	290-0526-00			CAP.,FXD,ELCTLT:6.8UF,20%,6V	90201	TDC685M006EL
C910	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C915	283-0644-00			CAP.,FXD,MICA D:150PF,1%,500V	00853	D151E151F0
C918	283-0644-00			CAP.,FXD,MICA D:150PF,1%,500V	00853	D151E151F0
C919	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C927	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z
C929	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z

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C959	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C968	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0
C978	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000C0H0689D
C989	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N080651475M
C990	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C998	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C1620	283-0659-00			CAP.,FXD,MICA D:1160PF,2%,500V	00853	D195C1161G0
C1710	285-0835-00			CAP.,FXD,PLSTC:0.22UF,2%,100V	56289	LP66A1B224G002
C1719	283-0058-00	B010100	B039999	CAP.,FXD,CER DI:0.027UF,10%,100V	72982	8131N147W5R273K
C1719	285-0683-00	B040000		CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	410P22351
C1730	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1780	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C1818	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1828	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1835	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C1866	283-0641-00			CAP.,FXD,MICA D:180PF,1%,100V	00853	D151E181F0
C1867	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	81314147 C 104K
C1912	283-0622-00			CAP.,FXD,MICA D:450PF,1%,300V	00853	D153F451F0
C1924	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000C0G0330J
C1931	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1946	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C1968	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1970	283-0593-00			CAP.,FXD,MICA D:0.01UF,1%,100V	00853	D301F103F0
C1974	285-0626-00			CAP.,FXD,PLSTC:0.0015UF,10%,100V	56289	410P102
C1992	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C1996	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C1998	283-0593-00			CAP.,FXD,MICA D:0.01UF,1%,100V	00853	D301F103F0
C2030	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C2730	283-0594-00	B010100	B029999	CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C2730	283-0597-00	B030000		CAP.,FXD,MICA D:470PF,10%,300V	00853	D153E471K0
C2810	283-0032-00	B010100	B039999X	CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C2929	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C2936	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C2958	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C3001	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3011	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3021	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3083	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C3121	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C3201	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3221	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3231	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C3241	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3242	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3251	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C3281	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C3283	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3331	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3333	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C3341	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3361	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C3381	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C3383	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC

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C3421	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100DC
C3431	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3441	283-0645-00			CAP.,FXD,MICA D:790PF,1%,100V	00853	D151E791F0
C3443	283-0645-00			CAP.,FXD,MICA D:790PF,1%,100V	00853	D151E791F0
C3461	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D151E700F0
C3470	281-0131-00			CAP.,VAR,AIR DI:2.4-24.5PF,250V	74970	189-509-5
C3473	283-0644-00			CAP.,FXD,MICA D:150PF,1%,500V	00853	D151E151F0
C3491	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8131N039Z5U-104Z
C3551	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C3565	281-0131-00			CAP.,VAR,AIR DI:2.4-24.5PF,250V	74970	189-509-5
C3601	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C3651	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C3711	283-0024-00	B010100	B059999X	CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8131N039Z5U-104Z
C3881	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4387	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5034	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C5041	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C5043	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5054	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5055	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C5056	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C5063	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C5065	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5122	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-00U2J0680K
C5145	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5182	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C5186	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5220	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5225	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C5244	283-0192-00			CAP.,FXD,CER DI:0.47UF,+80-20%,3V	91418	MX474Z0304R0
C5257	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C5288	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5316	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5332	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX104Z1201R0
C5344	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5360	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5364	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C5388	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5414	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX104Z1201R0
C5432	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5434	283-0192-00			CAP.,FXD,CER DI:0.47UF,+80-20%,3V	91418	MX474Z0304R0
C5458	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C5475	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5479	283-0017-00			CAP.,FXD,CER DI:1UF,+80-20%,3V	91418	MX105Z0304R0
C5522	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5545	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C5574	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5575	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5577	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5618	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5620	283-0676-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D105E820F0
C5622	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C5625	283-0676-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D105E820F0

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C5626	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C5648	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5650	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5674	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5680	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C5690	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C5718	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C5747	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5788	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C5815	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5824	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C5838	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C5866	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5919	283-0659-00			CAP.,FXD,MICA D:1160PF,2%,500V	00853	D195C1161G0
C5922	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	72982	855-535B222J
C5924	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C5929	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C5946	285-0879-00			CAP.,FXD,PLSTC:0.01UF,5%,400V	56289	LP66A1E103J002
C5950	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5956	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C5991	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C6008	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C6047	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C6051	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C6071	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C6078	283-0644-00			CAP.,FXD,MICA D:150PF,1%,500V	00853	D151E151F0
C6183	283-0000-00	XB010161	B039999X	CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C6372	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C6382	283-0635-00			CAP.,FXD,MICA D:51PF,1%,100V	00853	D151E510F0
C6395	285-0699-00	XB010161	B039999X	CAP.,FXD,PLSTC:0.0047UF,10%,100V	56289	610P110
C6486	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C6533	283-0643-00			CAP.,FXD,MICA D:22PF,+/-0.5PF,300V	00853	D103C220D0
C6562	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	72982	301-000C0G0220M
C6606	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C6608	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C6610	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C6614	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C6663	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C6665	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C6682	283-0004-00	B010100	B049999	CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C6682	283-0003-00	B050000		CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C6693	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C6712	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C6736	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8131N039Z5U-104Z
C6740	281-0611-00			CAP.,FXD,CER DI:2.7PF,+/-0.25PF,200V	72982	374-001C0J0279C
C6748	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C6763	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	8131N039Z5U-104Z
C6788	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-005
C6887	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C6979	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C7212	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C7301	283-0643-00			CAP.,FXD,MICA D:22PF,+/-0.5PF,300V	00853	D103C220D0
C7303	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0

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C7305	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D151E700F0
C7307	283-0667-00			CAP.,FXD,MICA D:420PF,1%,500V	00853	D155F421F0
C7309	283-0636-00			CAP.,FXD,MICA D:36PF,1.4%,100V	00853	D155E360G0
C7310	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C7311	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770F0
C7312	283-0603-00			CAP.,FXD,MICA D:113PF,2%,300V	00853	D153F1130G0
C7381	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D153F1050F0
C7383	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C7401	281-0516-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	301-000U2J0390K
C7403	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
C7431	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C7451	283-0111-00	B010100	B071249X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C7452	281-0547-00	B010100	B010160	CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C7452	SELECTED	B010161				
C7461	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-005
C7463	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-005
C7481	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C7491	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C7501	283-0601-00			CAP.,FXD,MICA D:22PF,10%,300V	00853	D153C220K0
C7503	283-0634-00			CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
C7505	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16.8D0
C7507	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C7508	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C7509	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C7533	283-0635-00			CAP.,FXD,MICA D:51PF,1%,100V	00853	D151E510F0
C7546	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C7551	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C7555	283-0598-00	B010100	B010160	CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C7555	283-0605-00	B010161		CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0
C7575	281-0547-00	B010100	B010160	CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C7474	SELECTED	B010161				
C7601	283-0601-00			CAP.,FXD,MICA D:22PF,10%,300V	00853	D153C220K0
C7603	283-0600-00			CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C7671	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C7681	290-0367-00			CAP.,FXD,ELCTLT:70UF,20%,6V NONPOLARIZED	56289	30D1802
C7711	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C7731	283-0640-00	B010100	B010160	CAP.,FXD,MICA D:160PF,1%,100V	00853	D151E161F0
C7731	283-0604-00	B010161		CAP.,FXD,MICA D:304PF,2%,300V	00853	D153F3040G0
C7781	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C7783	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C7791	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000C0K0808B
C7801	281-0626-00			CAP.,FXD,CER DI:3.3PF,1%,500V	72982	301-000C0J0339B
C7803	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C7861	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C7883	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C7891	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770F0
C7901	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C7903	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C7932	283-0164-00	B010100	B071249X	CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C7951	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C8004	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C8008	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C8009	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0

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C8044	283-0636-00			CAP.,FXD,MICA D:36PF,1.4%,100V	00853	D155E360G0
C8198	283-0150-00	B010100	B049999	CAP.,FXD,CER DI:650PF,5%,200V	72982	835-515B651J
C8198	283-0605-00	B050000		CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0
C8288	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C8292	283-0084-00	B010100	B049999	CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8292	283-0670-00	B050000		CAP.,FXD,MICA D:375PF,1%,500V	00853	D155F3750F0
C8294	283-0639-00	B010100	B049999	CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C8294	283-0669-00	B050000		CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C8324	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C8342	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C8350	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C8354	283-0639-00			CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C8362	281-0607-00			CAP.,FXD,CER DI:120PF,5%,500V	72982	302-000U2J121J
C8364	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C8382	283-0084-00	B010100	B010160	CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8382	283-0111-00	B010161		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C8421	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C8424	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C8472	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8480	283-0680-00	XB050000		CAP.,FXD,MICA D:330PF,1%,500V	00853	D15-5E331F0
C8488	283-0109-00	B010100	B010160	CAP.,FXD,CER DI:27PF,5%,1000V	56289	20C376
C8488	283-0615-00	B010161		CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C8492	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D153F1050F0
C8498	283-0648-00	B010100	B010160	CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100DC
C8498	281-0503-00	B010161		CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C8558	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8574	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8642	283-0054-00			CAP.,FXD,CER DI:150PF,5%,200V	72982	855-535U2J151J
C8652	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8654	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	72982	838-533B271J
C8674	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C8689	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C8698	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C8710	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C8832	283-0636-00			CAP.,FXD,MICA D:36PF,1.4%,100V	00853	D155E360G0
C8854	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C8972	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C8997	281-0116-00			CAP.,VAR,AIR DI:1.6-9.1PF,425V	74970	189-0354-075
C9011	290-0334-00			CAP.,FXD,ELCTLT:1250UF,+75-10%,50V	56289	D46468
C9042	290-0632-00			CAP.,FXD,ELCTLT:6200UF,+75-10%,15V	56289	39D357
C9044	290-0632-00			CAP.,FXD,ELCTLT:6200UF,+75-10%,15V	56289	39D357
C9061	290-0633-00			CAP.,FXD,ELCTLT:2400UF,+75-10%,30V	56289	39D360
C9082	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9084	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9086	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9088	281-0625-00			CAP.,FXD,CER DI:35PF,5%,500V	72982	308-000C0G0350J
C9209	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9215	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C9218	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9719	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C9726	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C9729	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C9745	283-0605-00			CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0

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C9753	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C9759	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C9766	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C9787	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C9792	283-0000-00	XB060000		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C9798	283-0144-00			CAP.,FXD,CER DI:33PF,1%,500V	72982	801-547P2G330G
C9799	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C9802	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C9810	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C9824	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C9830	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C9831	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C9832	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C9840	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C9850	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C9852	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C9854	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C9856	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
CR7	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR48	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR268	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR332	152-0141-02	XB071020		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR390	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR454	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR456	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR477	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR485	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR584	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR585	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR588	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR651	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR662	152-0141-02	XB070000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR664	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR720	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR740	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR796	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR924	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR944	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR992	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1010	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1020	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1030	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1040	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1050	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1205	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1305	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1670	152-0141-02	XB060000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1719	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1750	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1770	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR1827	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1848	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR1890	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1920	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1926	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3351	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3411	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3413	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3451	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3531	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3533	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3551	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3641	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3651	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3653	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3711	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR3721	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3723	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3725	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3811	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR3821	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3823	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3881	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3911	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR3913	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3920	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3921	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3923	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4390	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5010	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5012	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5038	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5040	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5253	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5258	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5274	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5276	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5334	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR5338	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5340	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5362	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5417	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR5419	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5480	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5490	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5492	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5521	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5572	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5576	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5651	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5660	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5667	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR5858	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5874	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5931	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR5935	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5952	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5974	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5981	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5984	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5985	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR5997	152-0008-00			SEMICOND DEVICE:GERMANIUM,75V,60MA	80009	152-0008-00
CR6013	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6017	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6019	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6022	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6028	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6033	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6037	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6112	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6113	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6114	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6118	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6122	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6128	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6132	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6136	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6182	152-0125-00			SEMICOND DEVICE:TUNNEL,15PF,4.7MA	80009	152-0125-00
CR6183	152-0141-02	XB010161	B039999X	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6306	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6308	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6316	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6318	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6322| CR6328|	152-0442-00			SEMICOND DEVICE:SILICON,MATCHED PAIR	80009	152-0442-00
CR6331	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6335	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6338	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6344	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6348 [1]	152-0442-00			SEMICOND DEVICE:SILICON,MATCHED PAIR	80009	152-0442-00
CR6376	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	28480	5082-2672
CR6404 [2]	152-0442-00			SEMICOND DEVICE:SILICON,MATCHED PAIR	80009	152-0442-00
CR6466	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6469	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2671
CR6588	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6603	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6624	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6634	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6703	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6705	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR6709	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6789	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6885	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6913	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6915	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

[1]Furnished as a unit with CR6404.
[2]Furnished as a unit with CR6348.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR6918	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6920	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6923	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6925	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6987	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6988	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7008	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7041	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7091	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7093	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7095	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7190	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7215	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7218	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7491	152-0141-02	XB010161		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7581	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7593	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7711	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7951	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8082	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8084	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8086	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8124	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8126	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8128	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8180	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8182	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8184	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8186	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8188	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8189	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8194	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8224	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8226	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8228	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8244	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8246	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8248	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8291	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8293	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8346	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR8384	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8385	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8520	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8524	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8536	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8910	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8924	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9610	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9612	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9614	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9616	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR9620	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9622	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9624	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9626	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9627	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9628	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9630	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9631	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9632	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9633	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9634	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9635	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9637	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9638	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9639	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9640	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9641	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9643	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9645	152-0 41-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9647	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9649	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9658	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9662	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9723	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9724	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9727	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9737	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9742	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9743	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9754	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9756	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9802	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	04713	1N4721
CR9804	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	04713	1N4721
CR9830	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9832	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9834	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9836	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9870	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9872	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9874	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR9876	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
DS9202	150-0048-00			LAMP,INCAND:5V,60MA	08806	683
DS9210	150-0048-00			LAMP,INCAND:5V,60MA	08806	683
DS9211	150-0048-00			LAMP,INCAND:5V,60MA	08806	683
DS9212	150-0048-00			LAMP,INCAND:5V,60MA	08806	683
F9201	159-0042-00			FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW	71400	AGC 3/4
F9202	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
FL9201	119-0095-06	B010100	B071209	FILTER,RAD INTE:400 HZ,250 VAC	56289	JN10-2319A1
FL9201	119-0389-00	B071210		FILTER,RFI:3A,115/230VAC,60HZ	02777	F11935-3
J9001	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9002	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
J9003	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9004	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9005	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9006	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9007	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9009	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9011	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9012	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9014	131-0324-00			CONNECTOR,RCPT,:24 PIN,FEMALE	71785	57-40240(398)
J9016	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9018	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9020	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9210	131-0106-02			CONNECTOR,RCPT,:BNC	80009	131-0106-02
J9240	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
J9250	131-0106-02			CONNECTOR,RCPT,:BNC	80009	131-0106-02
K370	148-0064-00			RELAY,REED:SPST	95348	CB-831A-26
K9080	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K9792	148-0086-00			RELAY,REED:SPDT,COIL 5V,150 OHM	78277	191TE1C15G
L20	114-0222-00			COIL,RF:2-6UH,CORE 276-0568-00	80009	114-0222-00
L120	114-0222-00			COIL,RF:2-6UH,CORE 276-0568-00	80009	114-0222-00
L190	114-0280-00			COIL,RF:12-43UH,CORE 276-0568-00	80009	114-0280-00
L415	114-0311-00			COIL,RF:65-190UH,CORE 276-0568-00	80009	114-0311-00
L435	114-0218-00			COIL,RF:70-120UH	80009	114-0218-00
L455	114-0218-00			COIL,RF:70-120UH	80009	114-0218-00
L475	114-0324-00			COIL,RF:200-300UH	80009	114-0324-00
L520	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D 500B
L720	108-0226-00			COIL,RF:100UH	76493	DWG B4257
L912	108-0443-00			COIL,RF:25UH	80009	108-0443-00
L1870	114-0308-00			COIL,RF:2.9-6.5UH	80009	114-0308-00
L1882	108-0443-00			COIL,RF:25UH	80009	108-0443-00
L1964	108-0174-00			COIL,RF:245UH	80009	108-0174-00
L3070	108-0395-00			COIL,RF:64UH	80009	108-0395-00
L5056	108-0317-00			COIL,RF:15UH	32159	71501M
L5100	114-0303-00			COIL,RF:6.5-23UH,CORE 276-0506-00	80009	114-0303-00
L5340	108-0174-00			COIL,RF:245UH	80009	108-0174-00
L5420	108-0174-00			COIL,RF:245UH	80009	108-0174-00
L5610	108-0317-00			COIL,RF:15UH	32159	71501M
L5830	108-0231-00			COIL,RF:4.5UH	80009	108-0231-00
L6482	276-0507-00	XB060000		SHIELDING BEAD,:0.6UH	78488	57-0180-7D 500B
L7110	120-0785-00			XFMR,TOROID:12 TURN BIFILAR	80009	120-0785-00
L7301	114-0280-00			COIL,RF:12-43UH,CORE 276-0568-00	80009	114-0280-00
L7311	114-0222-00			COIL,RF:2-6UH,CORE 276-0568-00	80009	114-0222-00
L7321	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D 500B
L7391	108-0249-00			COIL,RF:12UH	76493	70F125A1
L7401	114-0278-00			COIL,RF:4.6-16.7UH,CORE 276-0568-00	80009	114-0278-00
L7411	114-0220-00			COIL,RF:1-3UH,CORE 276-0568-00	80009	114-0220-00
L7501	114-0278-00			COIL,RF:4.6-16.7UH,CORE 276-0568-00	80009	114-0278-00
L7511	114-0220-00			COIL,RF:1-3UH,CORE 276-0568-00	80009	114-0220-00
L7601	114-0280-00			COIL,RF:12-43UH,CORE 276-0568-00	80009	114-0280-00
L7611	114-0220-00			COIL,RF:1-3UH,CORE 276-0568-00	80009	114-0220-00
L7631	108-0746-00	B010100	B010160	COIL,RF:53UH	80009	108-0746-00
L7631	108-0443-00	B010161		COIL,RF:25UH	80009	108-0443-00
L8007	114-0329-00			COIL,RF:900-1700UH	80009	114-0329-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
L8066	114-0254-00			COIL,RF:30-60UH,CORE NOT REPLACEABLE	80009	114-0254-00
L8140	114-0280-00			COIL,RF:12-43UH,CORE 276-0568-00	80009	114-0280-00
L8150	114-0281-00	B010100	B049999	COIL,RF:35-70UH,CORE 276-0540-00	80009	114-0281-00
L8150	114-0254-00	B050000		COIL,RF:30-60UH,CORE NOT REPLACEABLE	80009	114-0254-00
L8160	114-0278-00			COIL,RF:4.6-16.7UH,CORE 276-0568-00	80009	114-0278-00
L8290	114-0238-00	B010100	B049999	COIL,RF:300-470UH,CORE 276-0506-00	80009	114-0238-00
L8290	114-0248-00	B050000		COIL,RF:500-800UH,CORE 276-0506-00	80009	114-0248-00
L8381	114-0238-00	XB050000		COIL,RF:300-470UH,CORE 276-0506-00	80009	114-0238-00
L8390	114-0324-00	B010100	B049999	COIL,RF:200-300UH	80009	114-0324-00
L8390	114-0238-00	B050000		COIL,RF:300-470UH,CORE 276-0506-00	80009	114-0238-00
L8485	114-0324-00	XB050000		COIL,RF:200-300UH	80009	114-0324-00
L8580	114-0310-00			COIL,RF:22-80UH	80009	114-0310-00
L8590	114-0310-00	B010100	B010160	COIL,RF:22-80UH	80009	114-0310-00
L8590	114-0243-00	B010161		COIL,RF:40-118UH,CORE NOT REPLACEABLE	80009	114-0243-00
L8630	114-0257-00			COIL,RF:6-11UF	80009	114-0257-00
L8660	120-0587-00			XFMR,TOROID:FOUR 10 TURN WINDINGS	80009	120-0587-00
L8680	120-0524-00			XFMR,TOROID:12 TURNS QUADFILAR	80009	120-0524-00
L8730	114-0219-00	B010100	B049999	COIL,RF:45-130UH,20%	80009	114-0219-00
L8730	114-0310-00	B050000		COIL,RF:22-80UH	80009	114-0310-00
L9710	114-0218-00			COIL,RF:70-120UH	80009	114-0218-00
L9772	114-0310-00			COIL,RF:22-80UH	80009	114-0310-00
Q21	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q61	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q71	151-0164-00			TRANSISTOR:SILICON,PNP	80009	151-0164-00
Q81	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q91	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q141	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q151	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q171	151-0225-00			TRANSISTOR:SILICON,NPN	01295	SKA4799
Q181	151-0225-00			TRANSISTOR:SILICON,NPN	01295	SKA4799
Q271	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q321	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q331	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q351	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q381	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q391	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q394	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q398	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q406	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q408	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q411	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q421	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q428	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q449	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q466	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q498	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q510	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q520	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q540	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q550	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q560	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q565	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q570	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q580	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q620	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q630	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q640	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q658	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q680	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q730A,B	151-0104-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP8481
Q740	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q750	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q760	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q790	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q820	151-1039-00			TRANSISTOR:SILICON,JFE,P-CHAN	04713	2N5462
Q840	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q860	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q880	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q885	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q900	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q905	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q920	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q930	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q950	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q960	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q965	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q980	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q990	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q1278	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1640	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1650	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1700	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1720	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1730	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1750	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1800	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1801	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1820	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1840	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1880	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1881	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1900	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1901	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1910	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1911	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1920	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1930	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1940	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1980	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3040	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3050	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3060	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3070	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3110	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3130	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00

red

green red green

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q3210	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3240	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q3250	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3300	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3360	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q3370	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q3420	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3430	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q3440	151-1039-00			TRANSISTOR:SILICON,JFE,P-CHAN	04713	2N5462
Q3450	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q3470	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q3510	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q3520	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q3530	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q3540	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q3545	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q3580	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q3600	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3610	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q3645	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q3720	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3780	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q3820	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3825	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3880	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3890	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q3920	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q4071	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q4081	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q4091	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q5021	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5031	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5041	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q5051	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q5091	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q5121	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5141	151-0164-00			TRANSISTOR:SILICON,PNP	80009	151-0164-00
Q5151	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q5161	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5171	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5181	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5187	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q5191	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q5197	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5231	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5251	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5261	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5271	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5281	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5287	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q5331	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q5361	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q5371	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q5381	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5387	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5391	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5411	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q5421	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5431	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5441	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5447	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5451	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5457	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5461	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5467	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5481	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5487	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5491	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5511	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5521	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q5551	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q5561	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q5571	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q5581	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q5587	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q5591	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q5597	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5651	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5671	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5681	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q5691	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5697	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5721	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q5731	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q5751	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5781	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5831	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q5841	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5851	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5857	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5861	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5871	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5877	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5881	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5887	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5891	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5921	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q5931	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5937	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5941	151-0164-00			TRANSISTOR:SILICON,PNP	80009	151-0164-00
Q5951	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5961	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5971	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5981	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q5987	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q5991	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q5997	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6010	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6068	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q6091	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q6095	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6103	151-0127-00			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q6106	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6162	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q6164	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q6192	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q6198	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q6212	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6222	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6228	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6233	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6244	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6255	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6262	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q6266	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q6298	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6392	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6398	151-0216-00			TRANSISTOR:SILICON,PNP	04713	MPS6523
Q6478	151-0133-00			TRANSISTOR:SILICON,PNP	80009	151-0133-00
Q6482	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q6494	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q6496	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q6569	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6593	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q6624A,B	151-0361-00			TRANSISTOR:SILICON,NPN,DUAL	56289	TD702
Q6653A,B	151-0236-00			TRANSISTOR:SILICON,NPN	15818	SA2700
Q6715	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6758	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q6786	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q6803	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6813	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6824	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6828	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q6852	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q6858	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q6877	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q7001	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q7191	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q7221	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q7241	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q7321	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q7331	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q7431	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q7481	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q7531	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q7551	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q7571	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q7630A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q7651	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q7711	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q7763A,B	151-0236-00			TRANSISTOR:SILICON,NPN,DUAL	15818	SA2700
Q7771	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q7781	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q7783	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q7811	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q7911	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q7921	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q7961	151-0164-00			TRANSISTOR:SILICON,PNP	80009	151-0164-00
Q7971	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q7981	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q8038	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8071	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8148	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8150	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8158	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8166	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8171	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8172	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8261	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8271	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8279	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8281	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8321	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8371	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8461	151-0220-00	B010100	B049999X	TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q8461	151-0220-00	XB060000		TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q8471	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8571	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8579	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8641	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q8679	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q8851A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q8871A,B	151-0236-00			TRANSISTOR:SILICON,NPN,DUAL	15818	SA2700
Q8911	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q9035	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	80009	151-0349-00
Q9055	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	80009	151-0349-00
Q9085	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	80009	151-0349-00
Q9659	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9714	151-0230-00			TRANSISTOR:SILICON,NPN	80009	151-0230-00
Q9716	151-0230-00			TRANSISTOR:SILICON,NPN	80009	151-0230-00
Q9735	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q9745	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9776	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q9778	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q9800	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q9802	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q9804	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9806	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9830	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q9832	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q9834	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9836	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q9850	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q9852	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q9854	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q9856	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
R3	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R5	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R7	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R20	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R40	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R42	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R44	321-0105-00			RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121R0F
R61	322-0085-00			RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R62	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R68	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R70	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R72	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R74	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R78	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R94	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R96	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R142	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R144	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	91637	MFF1816G71500F
R162	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R164	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R166	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R168	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
R172	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R174	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R176	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R178	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R231	321-0235-00	B010100	B039999	RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R231	321-0243-00	B040000		RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R234	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R236	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R238	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R251	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R260	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
R267	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R284	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R296	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R298	322-0085-00			RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R301	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R312	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R329	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R332	315-0471-00	B010100	B071019X	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R333	315-0432-00	XB071020		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R334	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R336	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R338	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R351	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R356	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R358	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R362	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

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R364	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R366	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R368	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R377	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R379	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R382	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R384	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R386	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R387	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R399	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R407	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R408	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R409	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R415	315-0102-00	XB050000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R416	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R418	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R420	321-0293-00	B010100	B049999	RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
R420	321-0302-00	B050000		RES.,FXD,FILM:13.7K OHM,1%,0.125W	91637	MFF1816G13701F
R428	321-0309-00	B010100	B049999	RES.,FXD,FILM:16.2K OHM,1%,0.125W	91637	MFF1816G16201F
R428	321-0308-00	B050000		RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R429	321-0812-07			RES.,FXD,FILM:455 OHM,(NOM VALUE),SEL	91637	MFF1816C455R0B
R434	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R440	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R455	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R458	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R462	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R464	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R471	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R473	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R480	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R486	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R488	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R496	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R498	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R501	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R504	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	MFF1816G665R0F
R505	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R512	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R520	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R525	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R526	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R528	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R530	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R550	321-0152-00			RES.,FXD,FILM:374 OHM,1%,0.125W	91637	MFF1816G374R0F
R552	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R553	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
R555	321-0085-01			RES.,FXD,FILM:75 OHM,0.5%,0.125W	91637	MFF1816G75R00D
R562	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R566	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R576	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R583	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R586	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R587	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525

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R588	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R592	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R594	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R596	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R597	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R598	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R612	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R618	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R619	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R625	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R627	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R630	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R642	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R654	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R658	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R659	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R662	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R666	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R668	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R670	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R674	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R676	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R677	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R684	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R690	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R692	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R693	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R694	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R698	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R707	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R710	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R711	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R713	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R714	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R716	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R718	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R720	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R735	311-1272-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R740	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R746	315-0393-00	XB030000		RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R748	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R749	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R750	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R754	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R756	321-0183-00			RES.,FXD,FILM:787 OHM,1%,0.125W	91637	MFF1816G787R0F
R757	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R759	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R765	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R766[1]		B010100	B039999			
R766	315-0431-00	B040000		RES.,FXD,CMPSN:430 OHM,(NOM VALUE),SEL	01121	CB4315
R770	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R772	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R773	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235

[1]Added if necessary.

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R774	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R775	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R785	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R786	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R790	301-0821-00	B010100	B019999	RES.,FXD,CMPSN:820 OHM,5%,0.50W	01121	EB8215
R790	308-0542-00	B020000		RES.,FXD,WW:500 OHM,0.1%,3W	91637	RS2B-B500R0B
R806	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R808	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R817	321-0372-00			RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
R819	321-0374-00			RES.,FXD,FILM:76.8K OHM,1%,0.125W	91637	MFF1816G76801F
R820	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R821	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R840	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R842	321-0165-00			RES.,FXD,FILM:511 OHM,1%,0.125W	91637	MFF1816G511R0F
R843	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R845	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R847	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R848	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R849	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R850	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R854	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R856	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R862	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R863	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R868	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R870	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R872	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R874	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R876	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R883	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R888	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R890	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R893	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R895	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R896	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R897	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R898	301-0821-00	B010100	B019999	RES.,FXD,CMPSN:820 OHM,5%,0.50W	01121	EB8215
R898	308-0542-00	B020000		RES.,FXD,WW:500 OHM,0.1%,3W	91637	RS2B-B500R0B
R906	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R908	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R910	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R912	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R915	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R917	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R919	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R920	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R926	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R928	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R940	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R942	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R943	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R950	321-0183-00			RES.,FXD,FILM:787 OHM,1%,0.125W	91637	MFF1816G787R0F
R952	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825

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R954	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R955	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R957	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R958	321-0165-00			RES.,FXD,FILM:511 OHM,1%,0.125W	91637	MFF1816G511R0F
R959	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R965	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R966		B010100	B039999			
R966 [1]	315-0431-00	B040000		RES.,FXD,CMPSN:430 OHM,(NOM VALUE),SEL	01121	CB4315
R969	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R970	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R971	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R972	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R973	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R975	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R976	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R977	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R978	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R979	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R985	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R993	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R994	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R995	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R996	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R997	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R1001	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1005	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1110	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1208	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R1273	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1308	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R1372	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1610	315-0185-00			RES.,FXD,CMPSN:1.8M OHM,5%,0.25W	01121	CB1855
R1615	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1618	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1640	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1645	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1648	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1650	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1670	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1674	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1678	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1690	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1718	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R1720	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1734	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1758	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1790	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1810	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	MFF1816G63400F
R1812	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R1813	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1815	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1817	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1819	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

[1]Added if necessary.

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R1835	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1837	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1839	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1846	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R1854	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1862	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1864	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1894	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R1896	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1905	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R1907	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1915	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1918	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R1919	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	MFF1816G63400F
R1920	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1926	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1928	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1929	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1930	315-0153-00	B010100	B039999	RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1930	315-0203-00	B040000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1937	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R1939	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1946	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1948	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1949	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1950	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R1952	315-0155-00			RES.,FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
R1954	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1956	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1958	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R1976	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1978	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R1980	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1982	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1986	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R1987	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1989	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1994	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R1995	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1997	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R2701	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2706	301-0100-00	B010100	B039999X	RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R2710	315-0102-00	B010100	B039999X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2715	311-1266-00	B010100	B039999	RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3329P-L58-252
R2715	311-1268-00	B040000		RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R2720	321-0299-00	B010100	B010160	RES.,FXD,FILM:12.7K OHM,1%,0.125W	91637	MFF1816G12701F
R2720	321-0312-00	B010161	B039999	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R2720	321-0322-00	B040000		RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R2724	321-0341-00	XB010165	B039999	RES.,FXD,FILM:34.8K OHM,1%,0.125W	91637	MFF1816G34801F
R2724	321-0308-00	B040000		RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R2734	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2800	321-0341-00			RES.,FXD,FILM:34.8K OHM,1%,0.125W	91637	MFF1816G34801F
R2820	321-0318-00	B010100	B029999	RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F

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R2820	301-0102-00	B030000		RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R2882	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2910	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2915	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2918	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2920	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2922	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2932	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2934	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2970	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2978	301-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.50W	01121	EB2725
R2980	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3001	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R3003	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3005	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3007	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3013	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R3021	321-0082-00			RES.,FXD,FILM:69.8 OHM,1%,0.125W	91637	MFF1816G69R80F
R3031	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R3041	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3043	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3051	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3061	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3071	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3081	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3083	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3121	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R3123	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3125	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3126	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3141	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R3151	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3153	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3161	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3163	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3165	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3171	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R3181	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3183	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R3185	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3186	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R3211	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R3221	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R3223	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R3225	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3227	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R3241	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3260	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R3270	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R3271	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3281	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3283	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3285	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535

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R3311	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R3321	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R3323	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3325	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R3331	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R3335	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R3337	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R3341	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3343	321-0081-00			RES.,FXD,FILM:68.1 OHM,1%,0.125W	91637	MFF1816G68R10F
R3345	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3353	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3371	321-0081-00			RES.,FXD,FILM:68.1 OHM,1%,0.125W	91637	MFF1816G68R10F
R3373	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R3381	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R3383	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3385	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R3410	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R3411	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R3420	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R3431	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R3450	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R3451	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3453	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3481	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3491	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3511	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
R3513	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R3515	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R3517	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3521	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3523	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R3531	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R3541	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R3553	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3555	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3557	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3581	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3583	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3585	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R3610	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3616	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R3621	321-0343-00			RES.,FXD,FILM:36.5K OHM,1%,0.125W	91637	MFF1816G36501F
R3623	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R3625	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3641	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R3661	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3663	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3671	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R3711	321-0262-03			RES.,FXD,FILM:5.23K OHM,0.25@,0.125W	91637	MFF1816D52300C
R3713	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3791	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R3793	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R3795	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525

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R3811	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R3813	321-0336-00			RES.,FXD,FILM:30.9 OHM,1%,0.125W	91637	MFF1816G30901F
R3814	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R3840	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3890	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R3911	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3913	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R3916	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3961	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3993	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3995	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3997	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4073	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R4083	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R4086	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R4096	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R4276	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R4346	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R4380	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R4446	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R4546	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4580	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5020	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5024	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5030	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R5037	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R5039	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R5040	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R5045	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5048	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R5050	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5053	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R5055	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5057	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R5058	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R5060	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R5062	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R5068	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5070	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R5072	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5080	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
R5084	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R5090	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5120	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R5134	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5138	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R5151	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R5156	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5158	321-0338-00			RES.,FXD,FILM:32.4K OHM,1%,0.125W	91637	MFF1816G32401F
R5160	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R5162	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5165	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R5175	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535

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R5178	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R5188	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R5190	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R5198	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R5224	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R5226	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R5228	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5240	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5242	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5245	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R5248	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R5259	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5260	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R5262	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R5264	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R5266	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R5280	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5282	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5290	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R5292	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5298	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R5330	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R5345	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R5348	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5350	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R5352	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R5354	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R5355	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5358	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5374	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R5379	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5380	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5394	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5398	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R5412	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R5420	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5421	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5424	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5440	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R5459	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R5460	SELECTED					
R5468	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5470	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R5472	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R5474	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5476	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5478	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5488	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5489	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5490	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R5496	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R5523	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R5525	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225

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R5530	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R5534	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5536	SELECTED					
R5538	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R5540	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R5542	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5548	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R5550	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R5552	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5555	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5562	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5564	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5573	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5578	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5580	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R5582	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R5584	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5585	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R5586	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R5588	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5597	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R5598	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5616	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R5624	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5642	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R5644	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R5646	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5662	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5664	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5666	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5669	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5676	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R5678	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R5682	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R5684	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5690	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R5697	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R5698	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R5710	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R5716	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5720	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5734	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R5741	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R5745	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R5750	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R5751	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5753	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5762	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5774	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R5781	321-0331-00			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816G27401F
R5782	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R5784	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5786	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F

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R5791	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R5793	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R5796	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R5797	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R5798	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R5812	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5820	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5826	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R5828	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R5830	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5832	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R5840	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R5851	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R5863	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5864	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5880	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R5886	321-0331-00			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816G27401F
R5896	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5898	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5910	SELECTED					
R5912	SELECTED					
R5916	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R5918	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R5919	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5920	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R5926	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5928	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R5930	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5932	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R5934	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R5936	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5940	321-0310-00			RES.,FXD,FILM:16.5K OHM,1%,0.125W	91637	MFF1816G16501F
R5941	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R5943	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R5944	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5945	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5957	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5958	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5961	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5963	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5964	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R5966	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5968	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
R5970	321-0220-00	B010100	B049999	RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R5970	321-0218-00	B050000		RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R5971	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5975	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5976	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R5978	321-0705-00			RES.,FXD,FILM:41.7K OHM,1%,0.125W	91637	MFF1816G41701F
R5980	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R5982	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R5985	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R5986	321-0705-00			RES.,FXD,FILM:41.7K OHM,1%,0.125W	91637	MFF1816G41701F

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R5988	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R5989	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
R5990	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R5992	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5994	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5996	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5998	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5999	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R6005	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R6007	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R6008	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6071	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R6075	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R6082	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R6083	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R6086	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R6098	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R6108	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6117	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R6119	321-0277-00	B010100	B049999	RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R6119	321-0314-00	B050000		RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	MFF1816G18201F
R6122	321-0260-00	B010100	B049999	RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R6122	321-0276-00	B050000		RES.,FXD,FILM:7.32K OHM,1%,0.125W	91637	MFF1816G73200F
R6128	321-0233-00			RES.,FXD,FILM:2.61K OHM,1%,0.125W	91637	MFF1816G26100F
R6132	321-0233-00			RES.,FXD,FILM:2.61K OHM,1%,0.125W	91637	MFF1816G26100F
R6136	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R6142	321-0408-00	B010100	B010160	RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R6142	321-0393-00	B010161		RES.,FXD,FILM:121K OHM,1%,0.125W	91637	MFF1816G12102F
R6144	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R6148	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6152	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6154	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6158	322-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.25W	75042	CEBT0-1331F
R6164	323-0176-00			RES.,FXD,FILM:665 OHM,1%,0.50W	75042	CECT0-6650F
R6185	315-0102-00	XB010161	B039999X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6195	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R6198	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6202	311-1269-00			RES.,VAR,NONWIR:20K OHM,10%,0.50W	32997	3329P-L58-203
R6249	321-0393-00	B010100	B039999X	RES.,FXD,FILM:121K OHM,1%,0.125W	91637	MFF1816G12102F
R6284	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R6288	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R6304	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R6314	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R6324	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R6334	311-1266-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3329P-L58-252
R6344	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R6354	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R6362	311-1273-00			RES.,VAR,NONWIR:200K OHM,10%,0.5W	32997	3329P-L58-204
R6363	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R6364	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6368	321-0829-07			RES.,FXD,FILM:202 OHM,0.1%,0.125W	91637	MFF1816C202R0B
R6370	321-0829-07			RES.,FXD,FILM:202 OHM,0.1%,0.125W	91637	MFF1816C202R0B
R6375	SELECTED					

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R6384	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R6392	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6398	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R6448	321-0130-00			RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221R0F
R6463	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6467	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R6468	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R6472	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R6474	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R6504	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R6506	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
R6508	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R6512	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R6514	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
R6516	321-0219-00			RES.,FXD,FILM:1.87K OHM,1%,0.125W	91637	MFF1816G18700F
R6518	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	91637	MFF1816G30900F
R6522	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
R6524	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R6526	321-0130-00			RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221R0F
R6528	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R6531	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
R6533	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R6535	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R6537	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
R6539	321-0219-00			RES.,FXD,FILM:1.87K OHM,1%,0.125W	91637	MFF1816G18700F
R6542	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	91637	MFF1816G30900F
R6544	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
R6548	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R6552	321-0155-00			RES.,FXD,FILM:402 OHM,1%,0.125W	91637	MFF1816G402R0F
R6562	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R6566	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R6578	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R6579	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R6582	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6586	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R6612	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R6614	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R6634	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	91637	MFF1816G11000F
R6638	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	91637	MFF1816G15800F
R6642	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R6646	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R6648	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R6663	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R6637	311-1265-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R6677	321-0303-00			RES.,FXD,FILM:14K OHM,1%,0.125W	91637	MFF1816G14001F
R6684	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6687	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R6689	321-0300-00			RES.,FXD,FILM:13K OHM,1%,0.125W	91637	MFF1816G13001F
R6706	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R6724	321-0358-00			RES.,FXD,FILM:52.3K OHM,1%,0.125W	91637	MFF1816G52301F
R6728	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R6734	321-0369-00			RES.,FXD,FILM:68.1K OHM,1%,0.125W	91637	MFF1816G68101F
R6736	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503

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R6741	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R6758	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6791	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R6793	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6798	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R6833	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R6836	[illegible]	311-1266		RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R6842	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R6844	321-0231-00	B010100	B039999	RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R6844	321-0238-00	B040000		RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R6848	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R6859	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R6860	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R6864	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
R6868	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R6872	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6875	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6883	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R6892	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R6898	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R6904	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R6910	321-0330-00			RES.,FXD,FILM:26.7K OHM,1%,0.125W	91637	MFF1816G26701F
R6912	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R6920	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R6926	321-0310-00			RES.,FXD,FILM:16.5K OHM,1%,0.125W	91637	MFF1816G16501F
R6938	311-1269-00			RES.,VAR,NONWIR:20K OHM,10%,0.50W	32997	3329P-L58-203
R6942	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R6944	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R6956	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R6977	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R6981	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6983	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R6992	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R6996	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R7005	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R7030	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R7034	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R7131	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R7138	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R7143	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R7181	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R7215	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R7236	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R7237	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R7238	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R7240	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7241	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R7331	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7333	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R7341	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R7361	311-0613-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	80740	62-63-3
R7371	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7381	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

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R7383	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R7385	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R7441	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R7443	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R7445	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	91637	MFF1816G16201F
R7452	SELECTED					
R7453	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R7461	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R7490	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R7491	315-0222-00	B010100	B010160	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R7491	315-0152-00	B010161		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R7492	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R7542	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R7544	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R7551	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R7553	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R7554	315-0101-00	XB010161		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7555	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R7561	311-1223-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3386F-T04-251
R7564	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R7571	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R7575	SELECTED					
R7581	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R7583	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R7590	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R7591	315-0222-00	B010100	B010160	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R7591	315-0152-00	B010161		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R7615	311-0634-00	B010100	B010160	RES.,VAR,NONWIR:500 OHM,10%,0.50W	80740	62-55-3
R7615	311-0605-00	B010161		RES.,VAR,NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R7632	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R7634	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R7660	315-0101-00	XB010161		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7661	311-0634-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	80740	62-55-3
R7685	321-0187-00	B010100	B039999	RES.,FXD,FILM:866 OHM,1%,0.125W	91637	MFF1816G866R0F
R7685	321-0172-00	B040000		RES.,FXD,FILM:604 OHM,1%,0.125W	91637	MFF1816G604R0F
R7691	321-0235-00	B010100	B049999	RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R7691	321-0224-00	B050000		RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R7711	321-0165-00			RES.,FXD,FILM:511 OHM,(NOM VALUE),SEL	91637	MFF1816G511R0F
R7721	321-0105-00			RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121R0F
R7723	321-0172-00			RES.,FXD,FILM:604 OHM,1%,0.125W	91637	MFF1816G604R0F
R7725	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R7727	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R7729	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R7731	321-0126-00	B010100	B010160	RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R7731	321-0108-00	B010161		RES.,FXD,FILM:130 OHM,1%,0.125W	91637	MFF1816G130R0F
R7733	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R7735	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R7751	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R7753	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R7761	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R7763	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R7771	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7841	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F

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R7843	321-0191-00			RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953R0F
R7851	321-0230-00	B010100	B039999	RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R7851	321-0222-00	B040000		RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R7853	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
R7891	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R7893	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R7901	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R7911	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R7912	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R7913	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R7915	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R7921	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
R7923	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7931	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7933	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7935	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7941	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7943	321-0114-07			RES.,FXD,FILM:150 OHM,0.1%,0.125W	91637	MFF1816C150R0B
R7951	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R7953	301-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.50W	01121	EB8215
R7955	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R7961	321-0105-00			RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121R0F
R7963	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R7971	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R7973	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R7981	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R7983	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R7991	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R7993	311-1221-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	32997	3386F-T04-500
R7995	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R8008	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8009	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8024	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R8026	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8028	311-1226-00	B010100	B049999	RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R8028	311-1266-00	B050000		RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3329P-L58-252
R8045	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R8046	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8047	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R8049	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R8057	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R8058	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R8068	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R8070	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8071	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R8081	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	91637	MFF1816G84500F
R8088	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R8118	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8143	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8145	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8163	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R8165	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8171	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103

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R8172	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R8185	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R8230	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R8242	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R8262	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R8271	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R8272	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R8280	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R8284	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R8285	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R8287	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R8320	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8334	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R8335	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R8338	315-0122-00	B010100	B049999X	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R8338	315-0122-00	XB060000		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R8358	315-0471-00	B010100	B049999X	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R8358	315-0471-00	XB060000		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R8360	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R8366	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R8376	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R8378	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8380	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8381	311-1228-00	B010100	B049999	RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R8381	311-1268-00	B050000		RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R8431	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R8466	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R8474	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8494	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R8522	321-0328-00			RES.,FXD,FILM:25.5K OHM,1%,0.125W	91637	MFF1816G25501F
R8552	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R8554	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R8556	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8572	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8576	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R8578	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8621	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R8656	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8658	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R8659	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R8671	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8676	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8690	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R8752	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	91637	MFF1816G392R0F
R8754	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	91637	MFF1816G392R0F
R8756	315-0101-00	B010100	B049999X	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8783	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8834	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R8836	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R8838	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	MFF1816G18201F
R8852	321-0812-07	B010100	B049999	RES.,FXD,FILM:455 OHM,0.1%,0.125W	91637	MFF1816C455R0B
R8852	321-0187-00	B050000		RES.,FXD,FILM:866 OHM,1%,0.125W	91637	MFF1816G866R0F
R8864	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

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R8870	311-1225-00	B010100	B049999	RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R8870	311-1224-00	B050000		RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R8881	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R8884	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R8886	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R8888	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R8889	321-0812-07			RES.,FXD,FILM:455 OHM,0.1%,0.125W	91637	MFF1816C455R0B
R8896	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R8898	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R8906	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R8917	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8920	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R8934	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	MFF1816G18201F
R8938	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R8955	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R8974	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8980	321-0812-07			RES.,FXD,FILM:455 OHM,0.1%,0.125W	91637	MFF1816C455R0B
R8982	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
R8984	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R8986	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
R8988	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R8990	311-1223-00	B010100	B039999	RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3386F-T04-251
R8990	311-1222-00	B040000		RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R9080	302-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.50W	01121	EB1021
R9082	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R9205	311-1182-00			RES.,VAR,NONWIR:1.5K OHM,10%,0.5W	01121	W7835
R9209	311-1095-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	12697	382-CM40386
R9210	311-0585-00			RES.,VAR,NONWIR:15K OHM,20%,0.25W	71590	BA201-061
R9212	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R9215	311-0310-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R9223	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R9225	311-1095-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	12697	382-CM40386
R9230	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	91637	MFF1816G56200F
R9231	321-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
R9232	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R9233	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R9234	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R9235	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
R9236	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
R9237	321-0249-00			RES.,FXD,FILM:3.83K OHM,1%,0.125W	91637	MFF1816G38300F
R9238	321-0244-00			RES.,FXD,FILM:3.4K OHM,1%,0.125W	91637	MFF1816G34000F
R9239	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R9280	311-0361-00			RES.,VAR,NONWIR:500K OHM,20%	01121	W7684
R9285	311-0449-00			RES.,VAR,NONWIR:1.5K OHM,0.50W	01121	W-7704
R9290	311-0326-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	01121	W7683
R9291	321-1170-03			RES.,FXD,FILM:583 OHM,0.25%,0.125W	91637	MFF1816D583R0C
R9292	321-0180-03			RES.,FXD,FILM:732 OHM,0.25%,0.125W	91637	MFF1816D732R0C
R9293	321-0190-03			RES.,FXD,FILM:931 OHM,0.25%,0.125W	91637	MFF1816D931R0C
R9294	321-0202-03			RES.,FXD,FILM:1.24K OHM,0.25%,0.125W	91637	MFF1816D12400C
R9295	321-1216-03			RES.,FXD,FILM:1.76K OHM,0.25%,0.125W	91637	MFF1816D17600C
R9296	321-0233-03			RES.,FXD,FILM:2.61K OHM,0.25%,0.125W	91637	MFF1816D26100C
R9297	321-1254-03			RES.,FXD,FILM:4.37K OHM,0.25%,0.125W	91637	MFF1816D43700C
R9298	321-1283-03			RES.,FXD,FILM:8.76K OHM,0.25%,0.125W	91637	MFF1816D87600C

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R9299	321-1329-03			RES.,FXD,FILM:26.4K OHM,0.25%,0.125W	91637	MFF1816D26401C
R9629	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R9642	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R9654	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R9656	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
R9661	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R9664	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R9702	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R9704	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R9706	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R9708	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R9712	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R9716	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R9718	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R9721	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R9723	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R9728	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R9731	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R9732	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R9733	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R9738	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R9739	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R9741	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R9746	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R9747	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R9748	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R9754	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R9755	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R9758	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R9763	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R9764	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R9768	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R9796	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R9797	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R9800	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9801	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R9802	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9803	301-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.50W	01121	EB5105
R9804	308-0463-00	B010100	B071019	RES.,FXD,WW:0.3 OHM,1%,3W	91637	RS2B-KR3000F
R9804	308-0590-00	B071020		RES.,FXD,WW:0.25 OHM,5%,3W	91637	RS2B-ER2500J
R9806	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R9808	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	91637	MFF1816G11000F
R9810	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R9812	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R9814	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9816	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R9818	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R9830	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9831	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R9832	308-0245-00	B010100	B071019	RES.,FXD,WW:0.6 OHM,5%,2W	91637	RS2B162ER6000J
R9832	308-0499-00	B071020		RES.,FXD,WW:0.5 OHM,10%,2.5W AXIAL	91637	RS2B-ER5000K
R9834	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9836	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315

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R9838	321-0224-00			RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R9840	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R9842	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R9844	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R9846	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R9848	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R9850	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R9851	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R9852	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R9854	321-0172-00			RES.,FXD,FILM:604 OHM,1%,0.125W	91637	MFF1816G604R0F
R9856	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R9858	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R9860	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R9862	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R9864	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R9866	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9868	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R9870	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R9872	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R9874	308-0245-00	B010100	B071019	RES.,FXD,WW:0.6 OHM,5%,2W	91637	RS2B162ER6000J
R9874	308-0499-00	B071020		RES.,FXD,WW:0.5 OHM,10%,2.5W AXIAL	91637	RS2B-ER5000K
S9201	260-0834-00			SWITCH,TOGGLE:DPDT,5A,125VAC,0.25-40 THD	09353	7201SN260-834-1B
S9202[1]						
S9203[1]						
S9205	260-0731-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
S9212	260-1375-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-1375-00
S9213	260-1390-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-1390-00
S9225	260-0731-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
S9230	260-0621-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
S9235	260-1252-00			SWITCH,ROTARY:1 SECT,5 POSN,45 DEG	80009	260-1252-00
S9240	262-0976-00	XB050000		SWITCH,WIRED:ROTARY	80009	262-0976-00
S9240	260-1251-00			SWITCH,ROTARY:1 SECT,10 POSN,30 DEG	80009	260-1251-00
S9250	260-1383-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1383-00
S9253	260-0621-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
S9255	260-1376-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1376-00
S9260	260-1250-00			SWITCH,ROTARY:	76854	5-12191-411
S9265	260-1388-00			SWITCH,ROTARY:	76854	5-11771-410
S9275	260-1389-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1389-00
S9280	260-0621-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
S9285	260-0621-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
S9290	262-0975-00	XB050000		SWITCH,WIRED:ROTARY	80009	262-0975-00
S9290	260-1374-00			SWITCH,ROTARY:1 SECT,12 POSN,30 DEG	80009	260-1374-00
S9300	260-0731-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
S9320	260-0731-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
T9001	120-0737-00			XFMR,PWR,STPDN:	80009	120-0737-00
U101	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U201	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	07263	9390PC
U301	156-0143-00	B010100	B029999	MICROCIRCUIT,DI:RETRIGGERABLE MONOST/MV	01295	SN74122N
U301	156-0072-00	B030000		MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U321	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U339	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N

[1]See Mechanical Parts List. Line Voltage Selector.

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U359	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U430	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U450	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U470	156-0037-00			MICROCIRCUIT,DI:2-INPUT +AND/OR/INVERT GATE	80009	156-0037-00
U761	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHAN SW	80009	155-0022-00
U861	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHAN SW	80009	155-0022-00
U1010	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U1040	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1070	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U1090	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1210	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U1240	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1270	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U1290	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1310	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U1340	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1370	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	80009	156-0034-00
U1390	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1510	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	80009	156-0034-00
U1540	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1570	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U1590	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1770	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U1790	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U2001	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U2061	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2081	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2261	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2281	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2401	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U2461	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2481	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2661	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2681	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2721	156-0037-00			MICROCIRCUIT,DI:2-INPUT +AND/OR/INVERT GATE	80009	156-0037-00
U2741	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U2761	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2781	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2811	156-0172-00	B010100	B029999	MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	80009	156-0172-00
U2811	156-0072-00	B030000		MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U2831	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U2861	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U2881	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2911	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U2931	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U2961	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2981	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U3100	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U3585	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U3735	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U3755	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U3775	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U3835	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U3855	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U3875	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U4151	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U4281	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U4351	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U4381	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4481	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4551	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4581	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4621	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U4641	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U4651	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4681	156-0037-00			MICROCIRCUIT,DI:2-INPUT +AND/OR/INVERT GATE	80009	156-0037-00
U4721	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U4741	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U4751	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4781	156-0037-00			MICROCIRCUIT,DI:2-INPUT +AND/OR/INVERT GATE	80009	156-0037-00
U4821	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U4841	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4851	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4881	156-0037-00			MICROCIRCUIT,DI:2-INPUT +AND/OR/INVERT GATE	80009	156-0037-00
U5921	156-0172-00			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	80009	156-0172-00
U5967	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U6170	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U7291	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U8110	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U8620	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U8720	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U8820	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U8890	156-0130-00			MICROCIRCUIT,LI:BALANCED MODEM	04713	MC1496G
U9650	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
VR6484	152-0226-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6584
VR9850	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646
Y5730	158-0075-00			XTAL UNIT,QTZ:4.433619 MHZ,+/-0.0035%	80009	158-0075-00

SECTION 7

DIAGRAMS, WAVE FORMS, AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

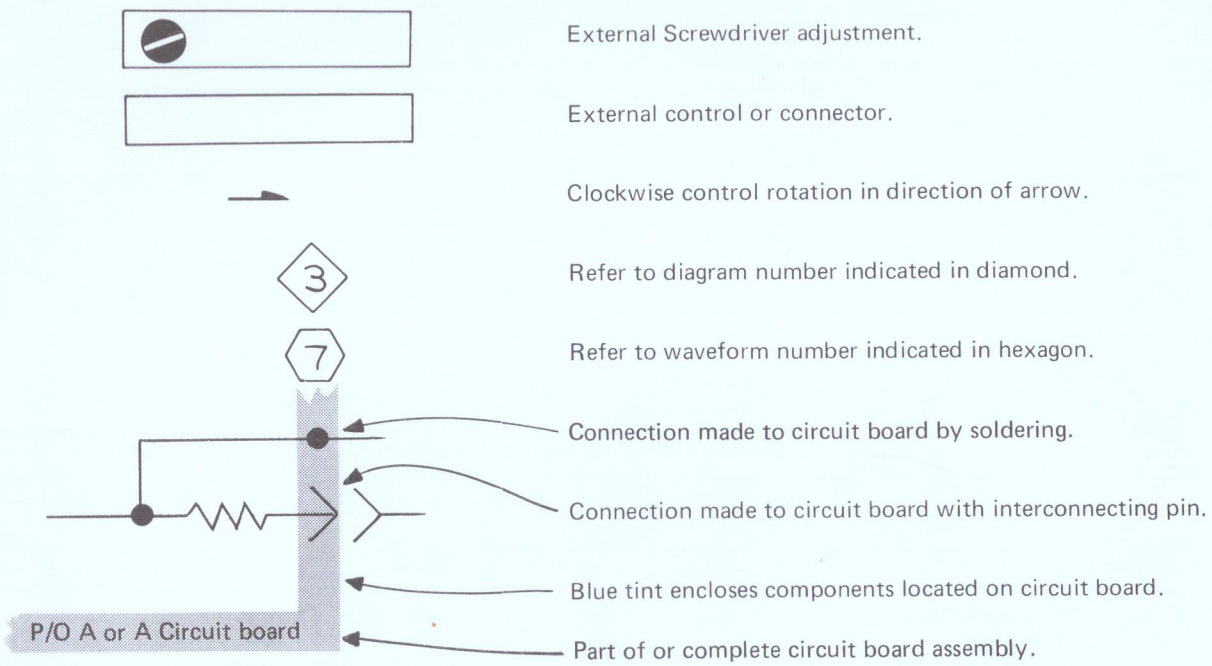
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

VOLTAGE AND WAVEFORM CONDITIONS

Circuit voltages measured with a 20,000 Ω/volt VOM; all readings in volts. Voltages are measured with respect to chassis ground unless noted otherwise.

Waveforms shown are actual photographs taken with a TEKTRONIX Oscilloscope Camera System. Test oscilloscope deflection factor and sweep rate conditions are noted on each waveform. DC coupling was used to obtain the DC levels that are recorded at the right side of each waveform. These DC levels are located with respect to the graticule rather than to the waveform. To indicate time relationship between signals, the test oscilloscope was triggered externally, where possible. The triggering source, except where noted was the 141A 25 Hz output.

Voltages and Waveforms on the diagram (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration, etc.

The test oscilloscope used for obtaining the waveform photographs had the following minimum characteristics: Deflection factor, 1 mV/Div (10 mV/Div with a 10X probe); frequency response, DC to 10 MHz; sweep rates, 0.05 μs/Div to 5 ms/Div.

Delayed sweep and delaying sweep are both displayed. The Delay Time Multiplier (DTM) setting is noted on each waveform.

WARNING

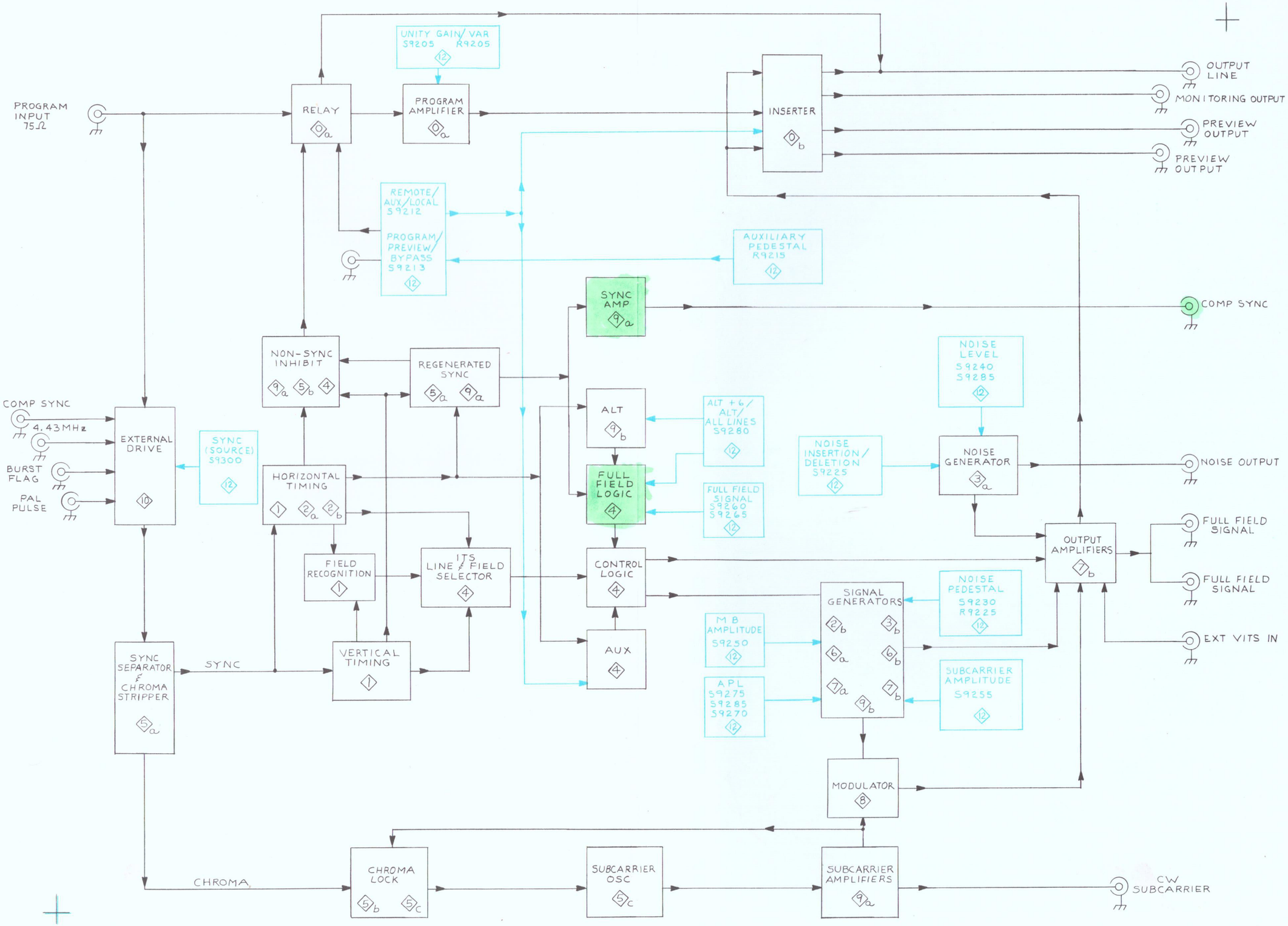
"Coaxial shields and ground lugs" are not always at ground potential. Check the diagram before using such connections as a ground for the VOM or test oscilloscope probe.

A TEKTRONIX Type 141A PAL TEST SIGNAL GENERATOR was used to provide an external 1 volt peak to peak composite video signal to the 148 PROGRAM INPUT 75 Ω

Unless noted otherwise on each diagram, the 148 switches were set as follows:

POWER	ON
SYNC	INT
INSERTION SIGNAL CONTROL	
UNITY GAIN/VAR	UNITY GAIN
PROGRAM/PREVIEW/AUXILIARY	PROGRAM
LOCAL/REMOTE	LOCAL
NOISE AND PEDESTAL	
NOISE	DELETION (Full Line)
PEDESTAL	700 mV
NOISE LEVEL dB	−20 dB
MULTIBURST AMPLITUDE	700 mV
LINEARITY	
SUBCARRIER	280 mV
Mode	10 STEPS
FULL FIELD SIG	
Mode	WINDOW
NORM/LINE RATE ONLY	NORM
ALT & 6 LINES	
FLAT FIELD/ALT/ALL LINES	ALL LINES
APL	FIELD SQ WAVE

The 148 OUTPUTS were all terminated with 75 Ω.



MEB/DAJ

BLOCK DIAGRAM

1

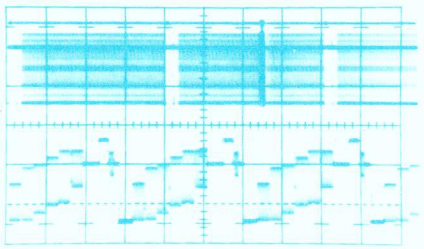
500 mV/DIV D.T.M.: 6.50

5 ms/DIV

0 V

20 µs/DIV

0 V



3

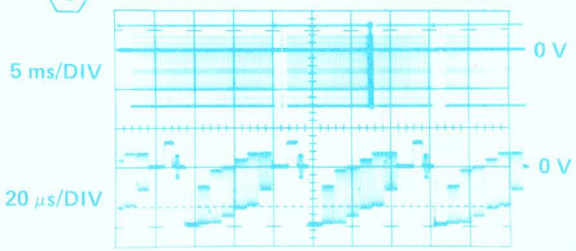
5 V/DIV D.T.M.: 6.50

5 ms/DIV

0 V

20 µs/DIV

0 V



2

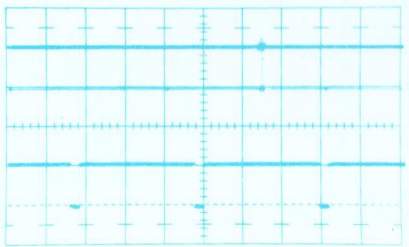
5 V/DIV D.T.M.: 6.50

5 ms/DIV

0 V

20 µs/DIV

0 V



4

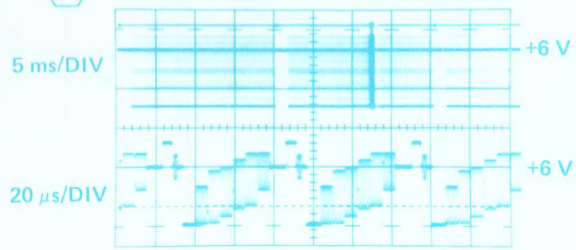
500 mV/DIV D.T.M.: 6.50

5 ms/DIV

+6 V

20 µs/DIV

+6 V

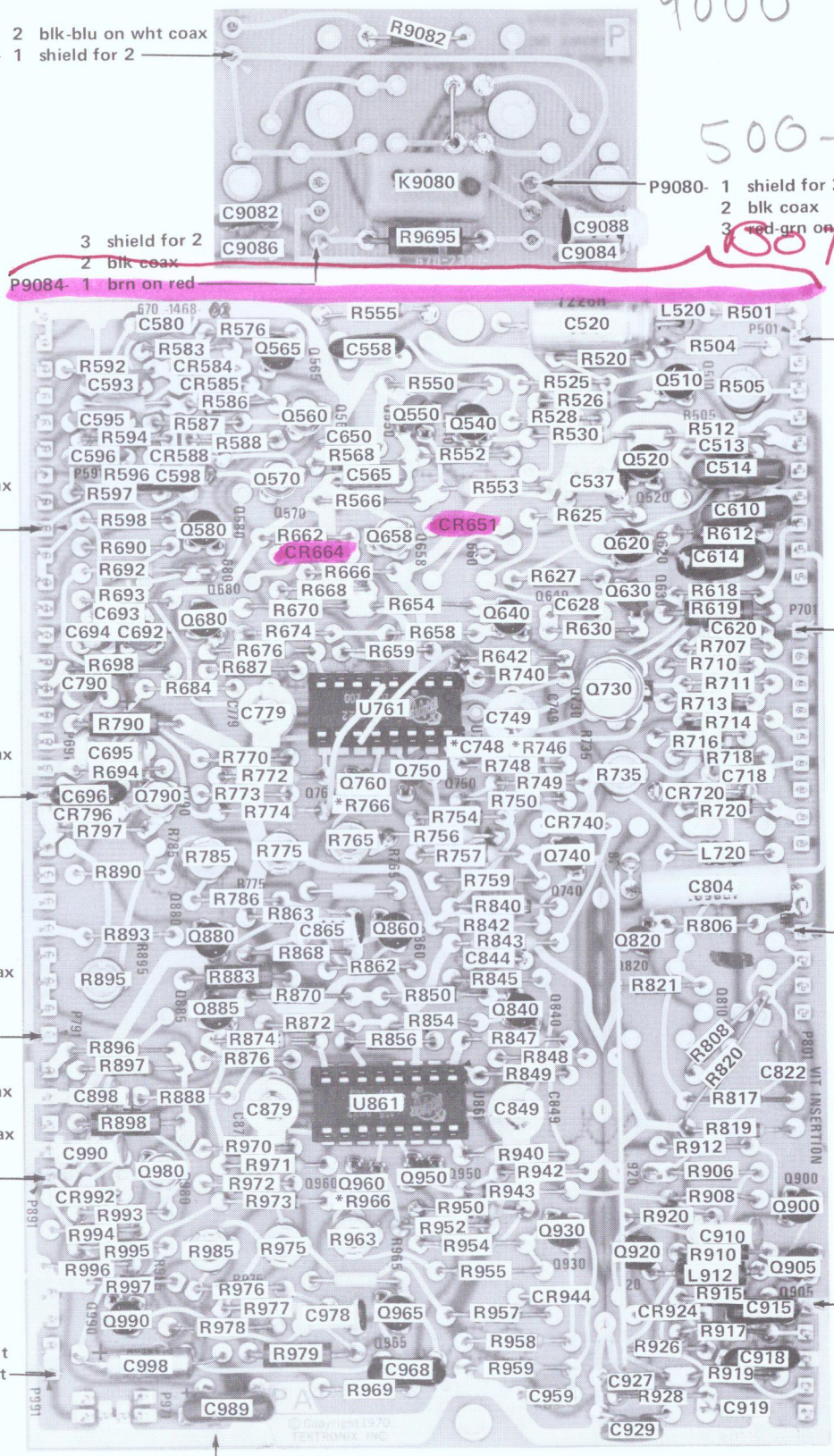


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

9000

506-900

Bottom



*See Parts List for serial number ranges.

REV. B, OCT. 1974

A13 — RELAY and AO-ITS INSERTION circuit boards

PROGRAM SIGNAL FROM P691-7 ◇b

A13 RELAY CIRCUIT BOARD

PROGRAM LINE OUT — J9007

P9080

C9088 35 — C9084 .01 — C9086 .01 — C9082 .01

K9080

R9080 1K

P9084 — +15V

P691 — S9212 ◇a — P9080 — P591

R598 100K — C693 .001

+5V — Q580 — R690 910 — R693 3.9K — -15V

U761-6 ◇b

P691 — NORM — P1400 ① — LINE RATE ONLY — P4080-4 ④

BYPASS INDICATOR

S9212 REMOTE/AUX/LOCAL — REMOTE — AUX — LOCAL — P701-3 ◇b

P801 — AUXILIARY PEDESTAL

+15V — R819 76.8K — R817 73.2K — -15V — R9215 5K — C9215 0.1

AUX IN J9210 — R9212 75

P701-5 ◇b

S9213 PROGRAM/PREVIEW/BYPASS — PROGRAM — PREVIEW — BYPASS

P591-6 ◇b

P991 — J9014-24 ⑫

P691-10 ◇a — C9218 .01

P971 — J9014-20 ⑫

(VAR) LEVEL — S9205 — R9205 1.5K VAR — UNITY GAIN

P501

+15 — R619 680 — R630 200 — C628 0.1 — P701

R625 1.0K — TP820 — C804 .56 — C620 270 — R707 56K

+15V — R612 6.8K — C537 4.3 — R627 100 — Q630 — Q620 — R720 47 — CR720 33

R501 360 — R505 500 — PROGRAM GAIN — R504 665 — R512 422 — R530 2K — Q510 — Q520

PROGRAM AMPLIFIER

C520 70µF — L520 — R520 100 — R555 75 — C558 10

R562 6.8K — R552 100 — Q540 — C565 1µF — R550 374 — R525 33K

-15V — TP660 — -11.2 V — R553 11.8K — Q550 — C650 0.1 — R566 3.16

R528 220 — +15V — R928 220 — C919 0.1 — R915 3.3K

R908 47 — Q900 — Q905 — C918 150 — C910 100 — R912 2K

+5V — R920 10 — C929 1µF — Q920 — L720 100µH — R806 1K

TP801 — TP920 — R906 6.8K

C718 .001 — R716 82K — R735 100K DIFF PHASE — R718 18K

P911 — COMP SYNC — P5294-3 ⑤a

R917 1K — L912 25µH — C915 150 — R919 15K — CR924

R820 470K — Q820 — C822 .005 — R808 4.7K

C927 1µF — R821 100

BACK PORCH GENERATOR

BACK PORCH CLAMP

PROGRAM INPUT 75Ω — J9009 — R9082 15K — P9082 — P9780-3 ⑩

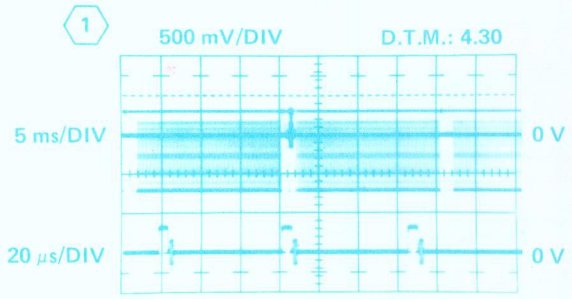
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

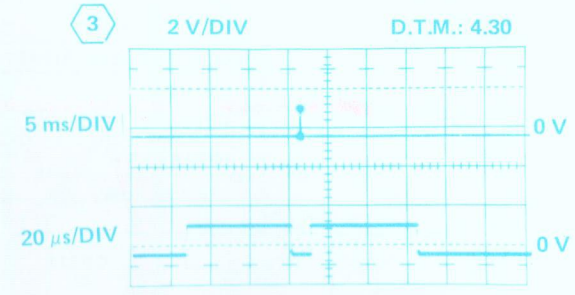
P/O AO ITS INSERTION CIRCUIT BOARD

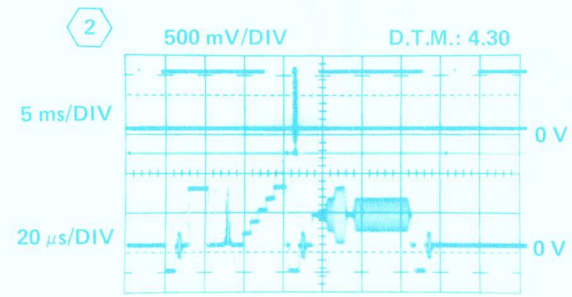
REV. B, OCT. 1974

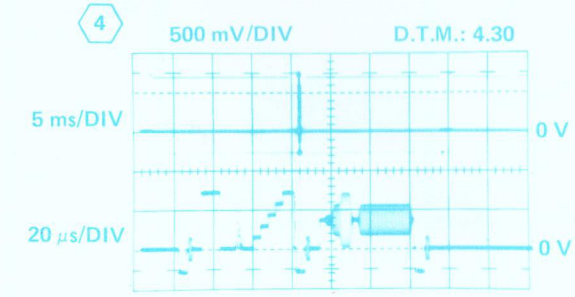
PROGRAM LINE AMPLIFIER ◇a

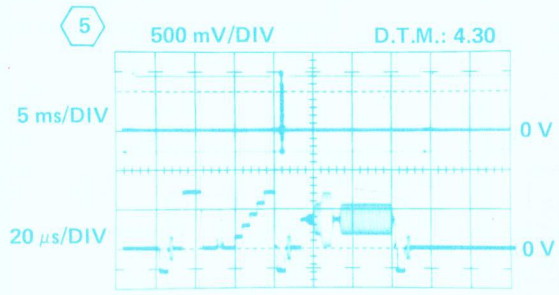
MEB/J. STORY









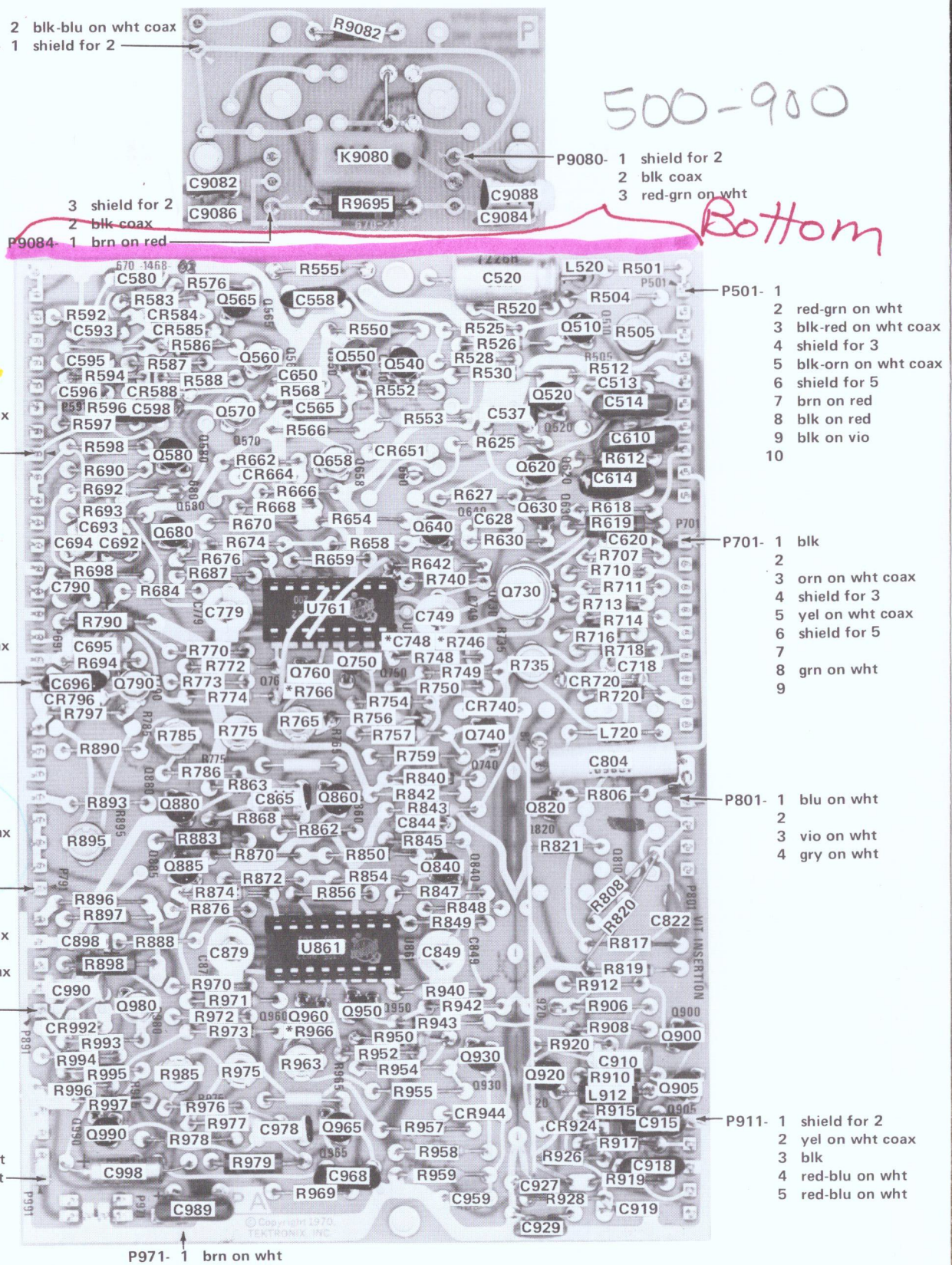


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

9000

500-900

Bottom



A13 — RELAY and AO-ITS INSERTION circuit boards

WAVEFORMS

PROGRAM ITS SWITCH

PROGRAM SWITCH

U761

PROGRAM SYNC LEVEL

PIN 4 LOW, PROGRAM CHANNEL ON (PINS 2 & 15)
PIN 4 HIGH, ITS CHANNEL ON (PINS 7 & 10)

PROGRAM CHROMA GAIN

PROGRAM MB ITS FLATNESS

PROGRAM LUMINANCE GAIN

PROGRAM OUTPUT AMPLIFIER

PROGRAM SIGNAL TO P9080-2 RELAY BOARD

PROGRAM MONITORING OUTPUT

PROGRAM BAND WIDTH

PROGRAM DC LEVEL

PREVIEW INDICATOR

PREVIEW PROGRAM LAMP INDICATOR P4080-1

ITS KEY P4590-5

ITS & FULL FIELD SIGNAL

FULL FIELD SIGNAL

FROM R690

PREVIEW ITS SWITCH

PREVIEW SWITCH

U861

PREVIEW SYNC LEVEL

PIN 4 LOW, PREVIEW CHANNEL ON (PINS 2 & 15)
PIN 4 HIGH, ITS CHANNEL ON (PINS 7 & 10)

PREVIEW FLATNESS

PREVIEW MB ITS FLATNESS

PREVIEW OUTPUT AMPLIFIER

PREVIEW GAIN

PREVIEW DC LEVEL

PREVIEW OUTPUT

SWITCH CONTROL

ITS SWITCH CONTROL

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

P/O A0 ITS INSERTION CIRCUIT BOARD

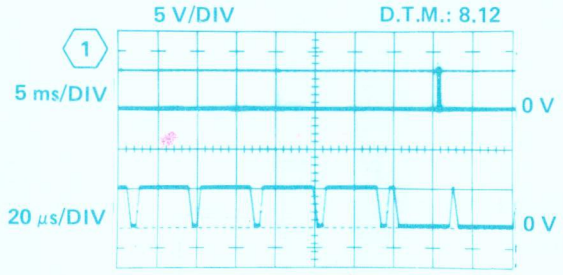
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

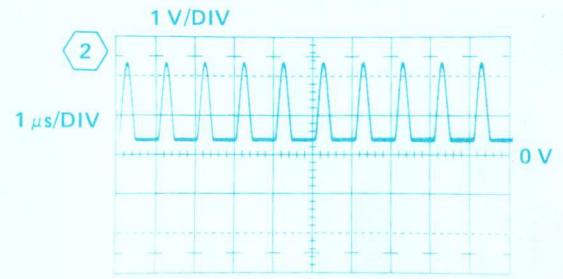
CR 622 on back of boards

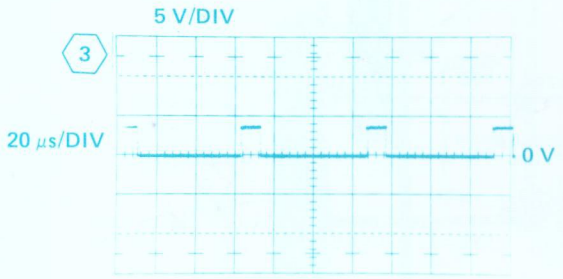
c694 & c614

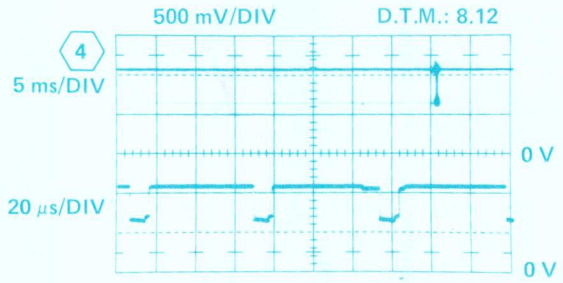
ITS INSERTER

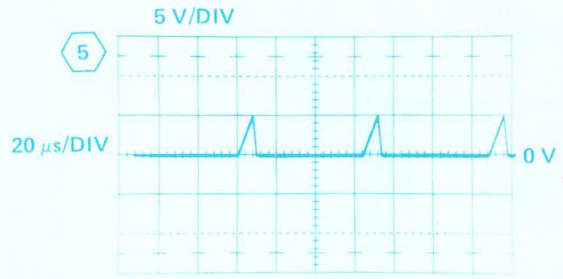
REV. C, JAN. 1976

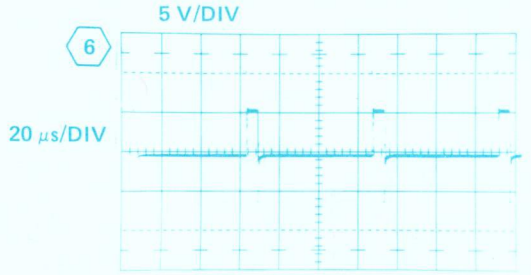


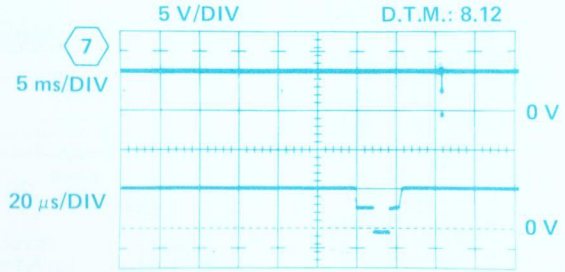


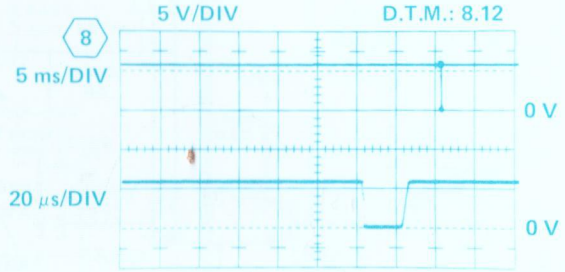


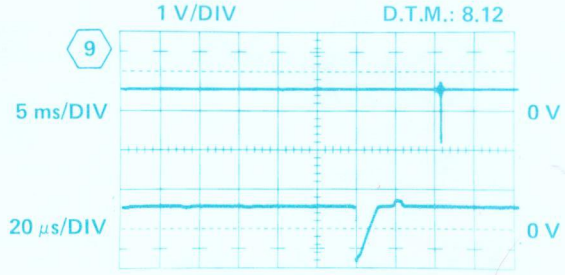


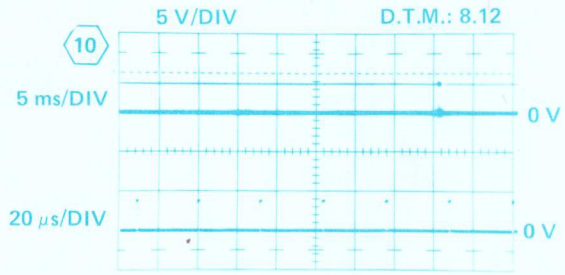






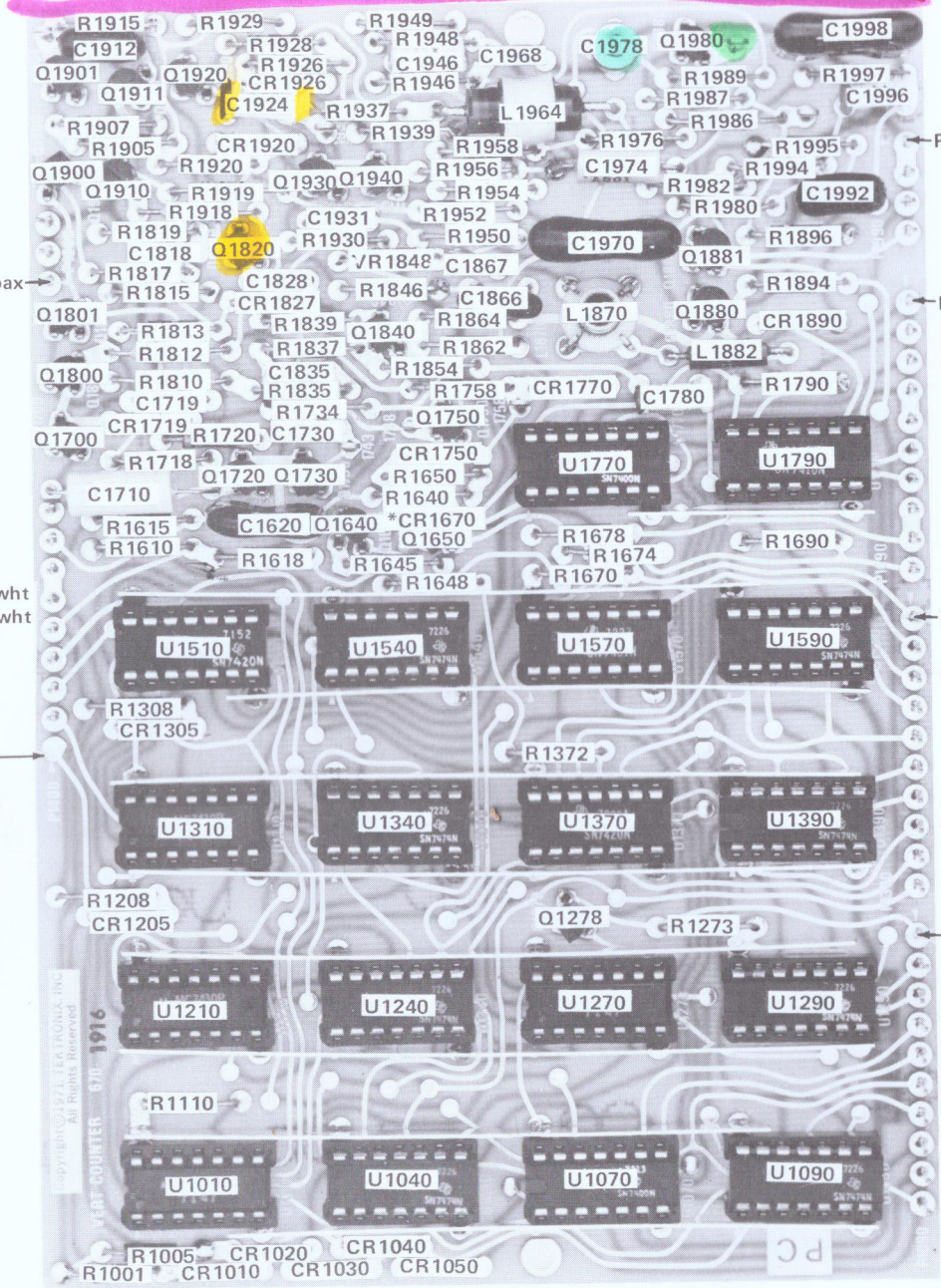






Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except Waveforms 2, 5 and 6, test oscilloscope internally triggered.

1000 Bottom



P1900-
1 orn on wht coax
2 shield for 1
3 blk

P1400-
1
2
3
4 blk on red
5 bk on vio
6 brn on red
7 orn-grn on wht
8 blk-red on wht

P1990-
1 blk
2
3
4 blk-orn on wht

P1690-
1 brn-red on wht
2 blk-gry on wht
3 blk-vio on wht
4 blk-blu on wht
5 blk-blu on wht
6 blk-orn on wht
7 blk-grn on wht
8 blk-yel on wht
9 blk-yel on wht
10

P1390-
1 brn on wht
2 blk on wht
3 gry on wht
4 blk-yel on wht
5 vio on wht
6 grn
7 red
8 brn
9
10

P1090-
1 blk-gry on wht
2 wht
3
4 blk-orn on wht
5
6
7
8
9 blk-red on wht
10

REV. B, OCT. 1974

A1 – VERT COUNTER circuit board

WAVEFORMS

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. UNUSED IC PINS GROUNDED
3. ALL IC'S; PIN 7 IS GROUND, PIN 14 IS V_{CC} (+5V).

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

A1 VERT COUNTER CIRCUIT BOARD

P1900?

AFC SAMPLER

1 MHz OSCILLATOR

64 μSEC COUNTER

ITS H BLANKING

HORIZONTAL INTEGRATOR

DELAYED FEEDBACK

FIELD RECOGNITION

MATRIX

VERTICAL INTEGRATOR

PEAK DETECTOR

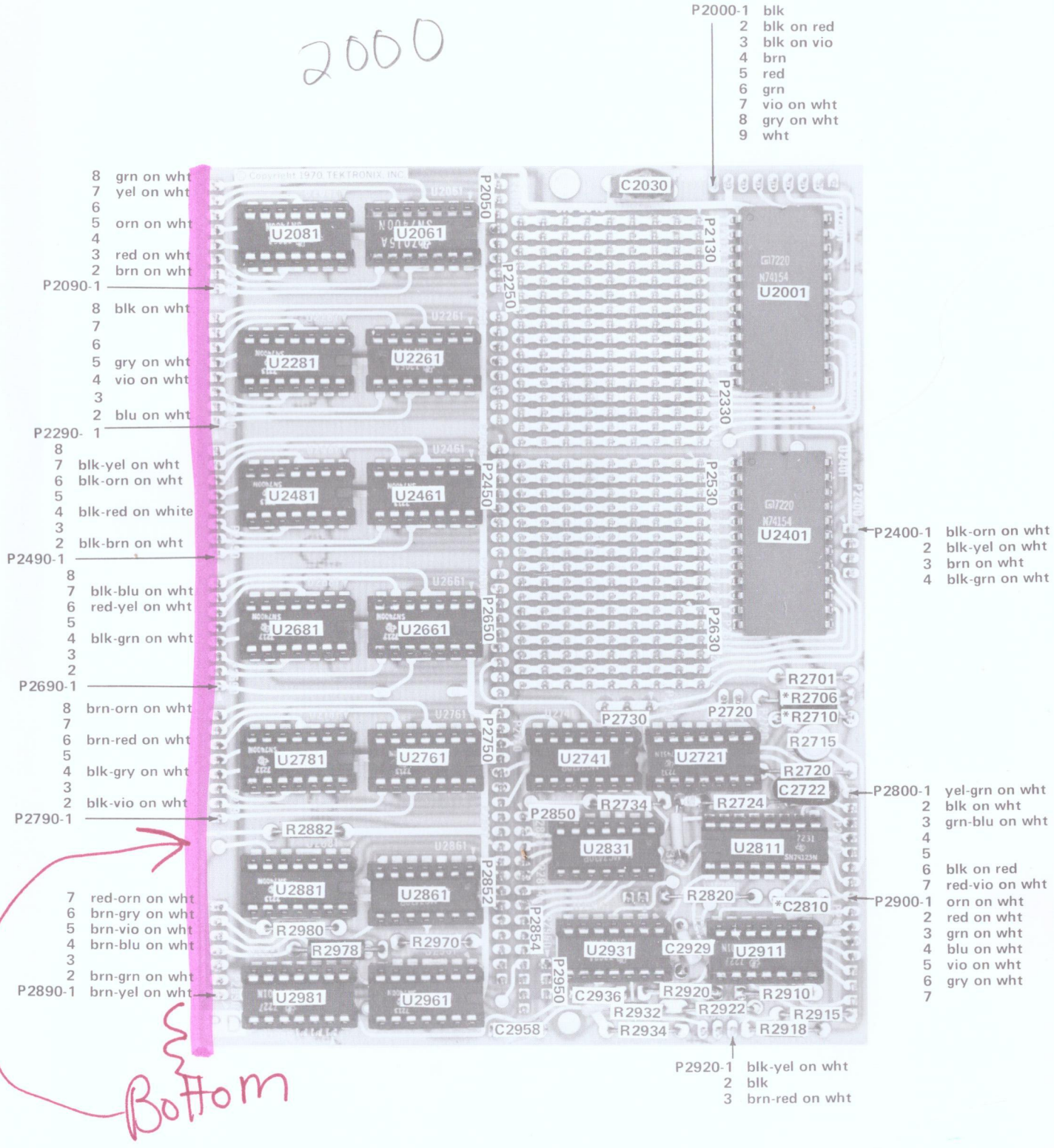
625 LINE COUNTER

CLOCK

REV. B. OCT. 1974

HORIZONTAL & VERTICAL COUNTER

JWL



*See Parts List for serial number ranges.

A2 – HORIZ TIMING circuit board

REV. B, OCT. 1974

NOTES:
1. 24 PIN IC'S: PIN 12 IS GROUNDED PIN 24 IS VCC, +5V
2. ALL OTHER IC'S: PIN 7 IS GROUNDED, PIN 14 IS VCC, +5V

P2400
P1390-4 (1)
15.625 KHz

P2000
(1) P1090-2
(1) P1390-3
(1) P1390-5
(1) P1390-6
(1) P1390-7
(1) P1390-8
500 KHz
15.625 KHz
31.25 KHz
62.5 KHz
125 KHz
250 KHz

P2000
-15V P3080-5 (3)a
+5V P3060-2 (3)a
-15V
+5V
C2030 100μF

U2001 74154N
U2401 74154N

P2400
P1690-6 (1)
P4080-6 (4)
P1690-7 (1)
TIME 15
TIME 32/0
TIME 31

COLOR CODE
INSTANTS OF TIME DURING H INTERVAL
INSTANT DECODER

P2130
CONNECTOR CODE
P7003-1 (7)b
P2330
C6183 (6)a
P301-6 (9)a
P301-7 (9)a
P2530
P2630
P401-4 (9)b
P301-5 (9)a
P301-8 (9)a
P401-5 (9)b

SET/RESET

NOISE ½ LINE INSERT
H BLANKING
LINE 331 CHROMA REF.
WINDOW BAR TIMING
RAMP TIMING
WINDOW MOD PULSE TIMING
LINE 331 CHROMA 3 LEVEL
LINE 331 CHROMA 3 LEVEL
MB WHITE REF.
LINE 17/330 BAR
LINE 331 CHROMA 3 LEVEL
MB 350 MV

H INTERVAL TIME INSTANTS
CONNECTOR CODE
P2050
U2081 A&B 4700N
U2061 A&B 4700N
U2061 C&D 4700N
U2081 C&D 4700N
P2250
U2281 A&B 7400N
U2261 A&B 7400N
U2261 C&D 7400N
U2281 C&D 7400N
P2450
U2481 A&B 7400N
U2461 A&B 7400N
U2461 C&D 7400N
U2481 C&D 7400N

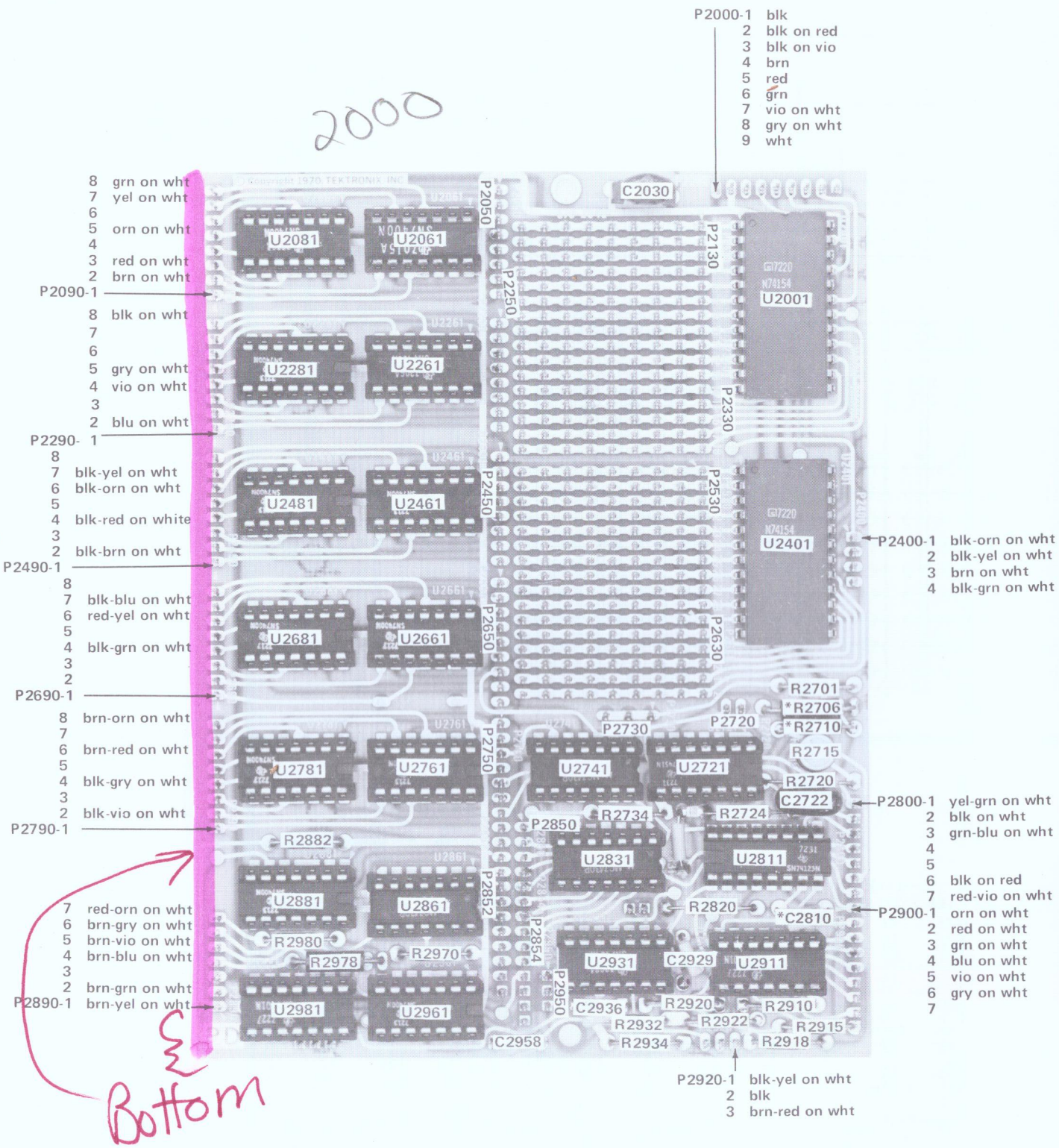
P/O A2
HORIZ. TIMING CIRCUIT BOARD

P2090
P4590-6 (4)
P3930-2 (3)b
P3890-3 (3)b
P8070-6 (8)
P2900-2 (2)b
P2290
P3930-10 (3)b
P2800-2 (2)b
P8090-5 (8)
P8090-8 (8)
P2490
P6035-9 (6)a
P6904-5 (6)b
P2920-1 (2)b
P8090-7 (8)b
P6904-4 (6)b

REV B, OCT. 1974

HORIZONTAL TIMING (2)a

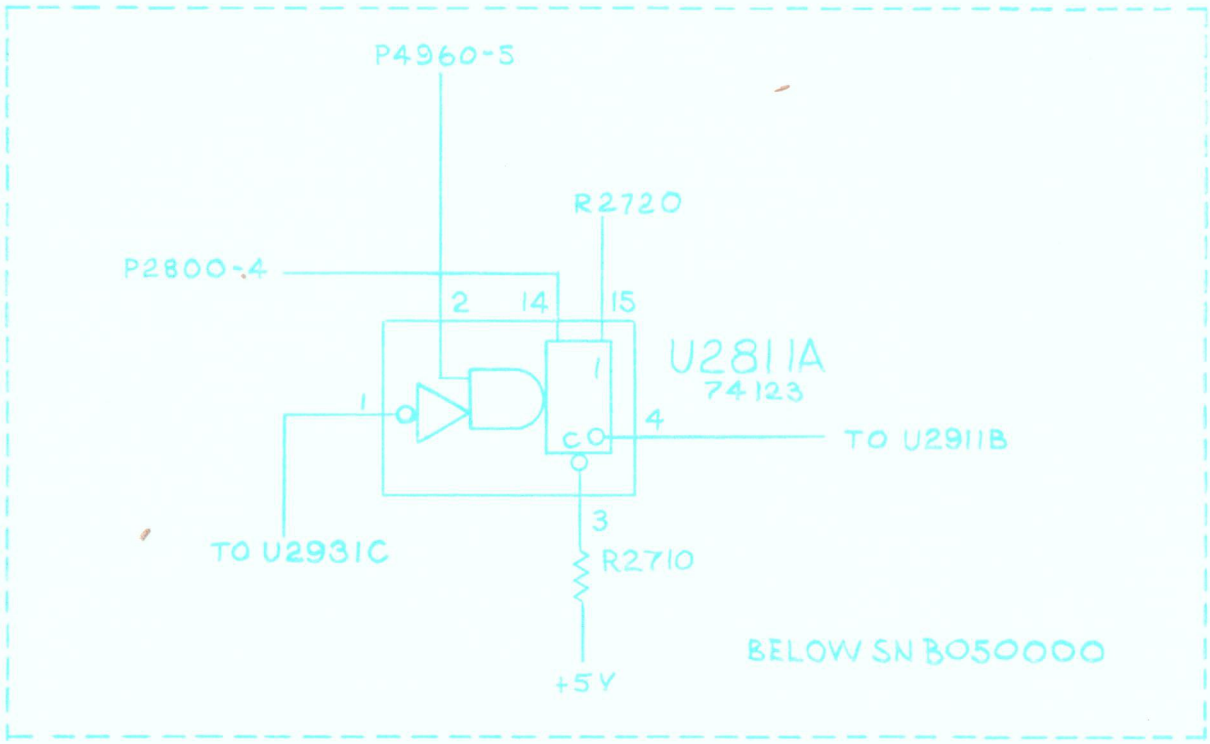
DAJ/MEB

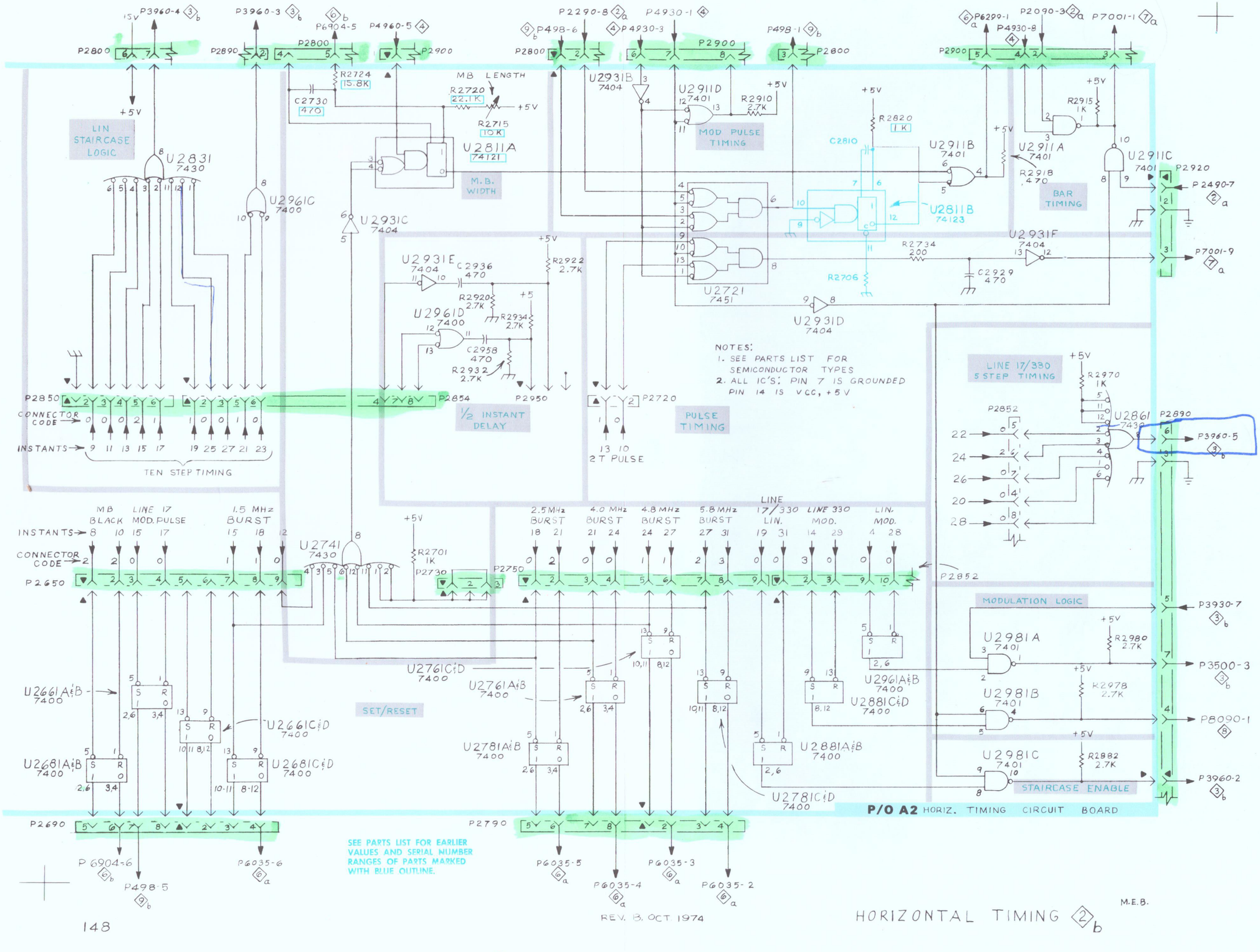


*See Parts List for serial number ranges.

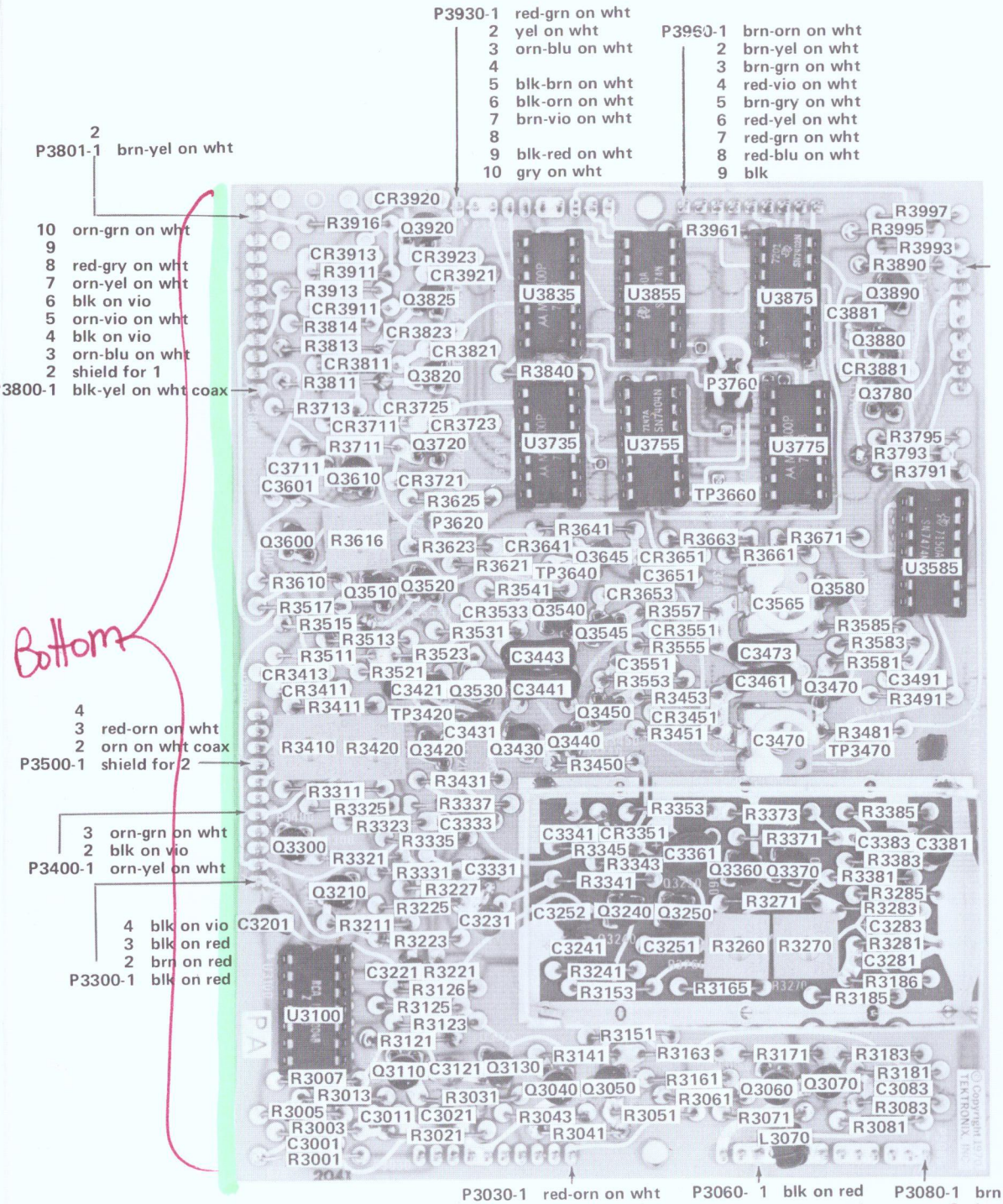
A2 – HORIZ TIMING circuit board

REV. B, OCT. 1974


P4960-5
R2720
P2800-4
2
14
15
U2811A
74123
1
1
4
C
TO U2911B
TO U2931C
3
R2710
+5V
BELOW SN B050000


LIN STAIRCASE LOGIC
U2831 7430
U2961C 7400
U2931C 7404
M.B. WIDTH
U2811A 74121
MB LENGTH
R2720 22.1K
R2715 10K
R2724 15.8K
C2730 470
MOD PULSE TIMING
U2911D 7401
U2931B 7404
R2910 2.7K
BAR TIMING
U2911A 7401
U2911B 7401
U2911C 7401
R2820 1K
C2810
R2818 470
U2811B 74123
R2915 1K
U2931F 7404
R2734 200
C2929 470
R2706
U2721 7451
U2931D 7404
U2931E 7404
C2936 470
R2922 2.7K
R2920 2.7K
R2934 2.7K
U2961D 7400
C2958 470
R2932 2.7K
1/2 INSTANT DELAY
PULSE TIMING
2T PULSE
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. ALL IC'S; PIN 7 IS GROUNDED PIN 14 IS VCC, +5V
LINE 17/330 5 STEP TIMING
U2861 7430
R2970 1K
TEN STEP TIMING
INSTANTS → 9 11 13 15 17 19 25 27 21 23
CONNECTOR CODE
P2850
P2854
P2950
P2720
P2852
P2890
P3960-5
MB BLACK
LINE 17 MOD. PULSE
1.5 MHz BURST
2.5MHz BURST
4.0 MHz BURST
4.8 MHz BURST
5.8MHz BURST
LINE 17/330 LIN.
LINE 330 MOD.
LIN. MOD.
INSTANTS → 8 10 15 17 15 18 12 18 21 21 24 24 27 27 31 19 31 14 29 4 28
CONNECTOR CODE
P2650
P2750
P2730
U2741 7430
R2701 1K
U2761C&D 7400
U2761A&B 7400
U2661A&B 7400
U2661C&D 7400
U2681A&B 7400
U2681C&D 7400
U2781A&B 7400
U2781C&D 7400
U2881A&B 7400
U2881C&D 7400
U2961A&B 7400
SET/RESET
MODULATION LOGIC
U2981A 7401
U2981B 7401
U2981C 7401
R2980 2.7K
R2978 2.7K
R2882 2.7K
STAIRCASE ENABLE
P3930-7
P3500-3
P8090-1
P3960-2
P2690
P2790
P6904-6
P498-5
P6035-6
P6035-5
P6035-4
P6035-3
P6035-2
P/O A2 HORIZ. TIMING CIRCUIT BOARD
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
REV. B, OCT 1974
M.E.B.
HORIZONTAL TIMING 2b

3000



A3 – APL STAIRCASE & NOISE circuit board

Ⓐ

P/O A3 APL STAIRCASE & NOISE CIRCUIT BOARD

NOTE:
SEE PARTS LIST FOR
SEMICONDUCTOR TYPES

SHIELD

NOISE PRE-AMP

NOISE AMPLIFIER

NOISE GENERATOR

+15V (DCPL) C3001 1.0 R3005 47 C3201 1.0
+5V (DCPL) C3331 1.0 R3223 10 C3221 1.0 R3121 2.7
R3013 12K C3011 1.0 -15V C3021 1.0
P3300 2 +15V P9832 (11)
3 +5V P9802 (11)
4 +5V (FRONT PANEL) (12)
-15V P9852 (11)

+15V (DCPL) R3007 1K C3121 22µF Q3130 Q3110 -15V
P3030 5 J9240 NOISE OUT
6 R3021 69.8 R3031 49.9
7 P7691-6 (7)b
R3003 2.7K -15V
R3083 4.7K C3083 .01 Q3040 +15V
4 R3043 1.5K R3151 22K OFF
R3141 18 Q3050
3 R3041 1.5K R3051 22K -50
R3163 47 Q3060
2 R3061 1.5K R3161 22K -40
R3171 180 Q3070
1 R3071 1.5K R3081 22K -30
R3183 1.8K R3181 10K -15V
0 -20
S9235
S9240 NOISE LEVEL dB (12)

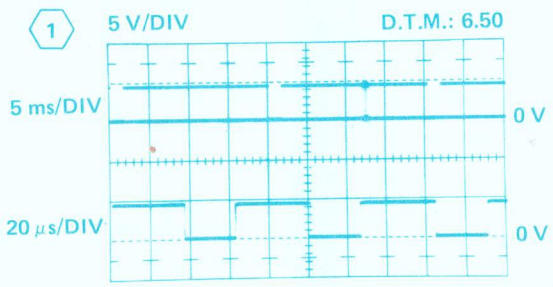
+15V CR3351 R3345 3.9K Q3240
C3341 1µF R3381 22 C3283 1µF R3185 1K
NOISE AMPLITUDE R3260 1K C3251 .01 R3283 4.7K
R3271 2K Q3360 R3281 1K R3165 1K NOISE BANDWIDTH R3270 20K
R3285 15K Q3370 R3343 68.1 R3341 2K R3241 1K
R3383 15K R3371 68.1 R3186 6.8K -15V C3281 .01
C3381 15µF R3385 100 R3373 1.3K C3383 100µF -15V
R3353 3.9K C3361 100µF -15V R3153 47 C3241 1.0 C3242 1µF -15V

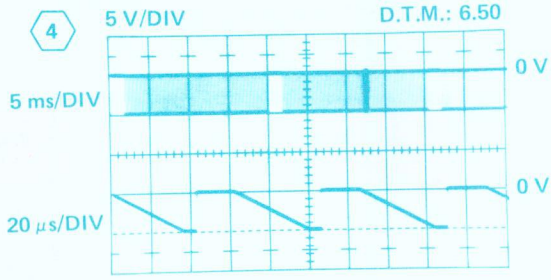
C3231 22µF R3225 47 Q3250 Q3210
+5V (DCPL) R3331 470 R3211 510
R3227 2.2K U3100E R3126 3.9K R3125 10K -15V
R3221 2.4K -15V R3321 510
R3335 2K R3323 47 Q3300 C3333 .01
R3325 470 +5V (DCPL)
U3100A U3100C U3100B U3100D R3001 15.0K R3123 1.5K -15V +15V (DCPL)

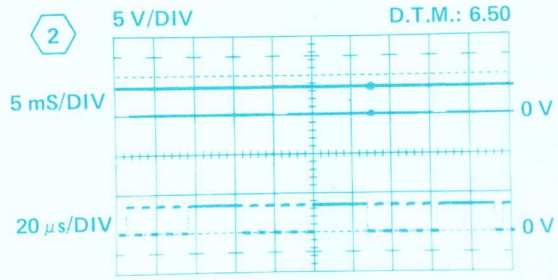
L3070 64µH
P3060 3 1 2 +5V P9802 (11) P2000-2 (2)a
P3080 7 4 5 6 1 2 3 (11) -15V P9852 (11) +15V P9832 FRONT PANEL SWITCHING TO P2000-3 (2)a FRONT PANEL SWITCHING (12)
P3960 9
P3030 10 9
-9 -8 -7 -6 -5 -4 -3 -2 -1 0
R9239 3.16K R9238 3.40K R9237 3.83K R9236 4.64K R9235 5.49K R9234 6.65K R9233 8.25K R9232 9.53K R9231 11.5K

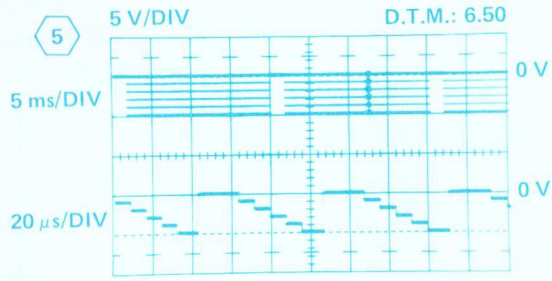
NOISE GENERATOR (3)a hq/RHL MEB 0472

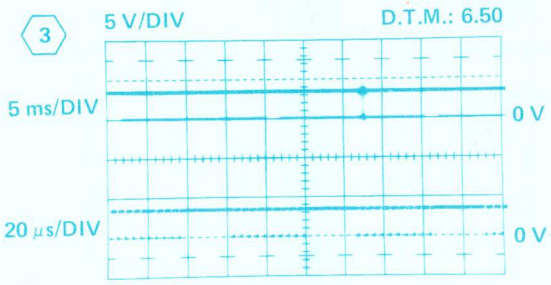
NOISE GENERATI

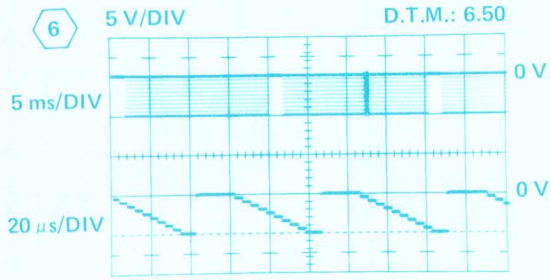








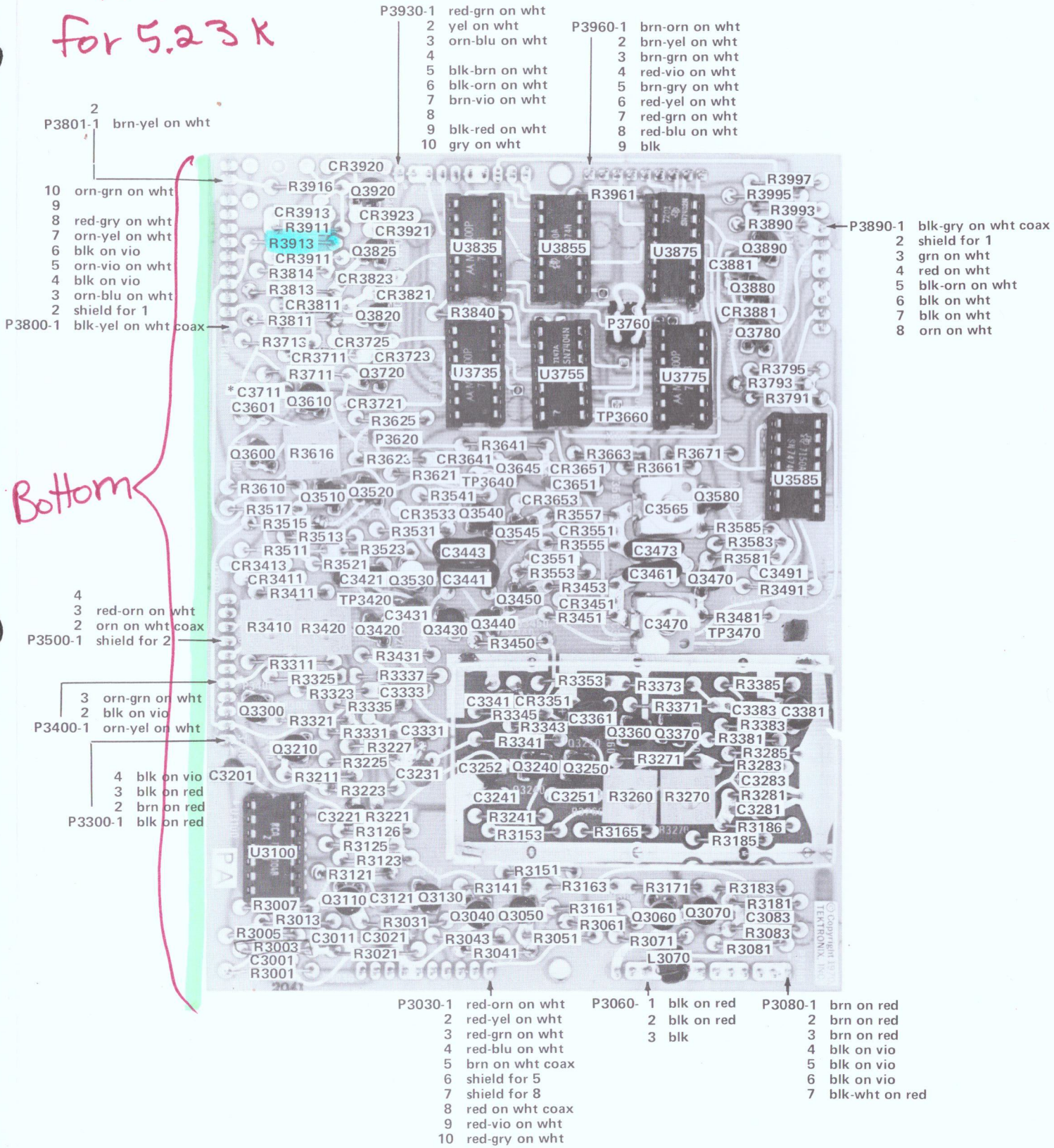




Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except: All Waveforms, FULL FIELD SIG Mode switch set to LINEARITY; Waveform 1 & 4, LINEARITY Mode switch set to RAMP; and Waveform 2 & 5, LINEARITY MODE switch set to 5 STEP.

if step
148 13 bad check
for 5.23 K

3000



A3 — APL STAIRCASE & NOISE circuit board

WAVEFORMS

P/O A3 APL STAIRCASE & NOISE CIRCUIT BOARD

BOUNCE RATE R9280

P3890

S9275 FIELD SQ WAVE

P401-7

P2890-7

P890-3

280mV MOD AMPLITUDE

140 mV MOD AMPLITUDE

P3500

P3930

H BLANKING

FLAT FIELD ENABLE

GND. FOR WHITE

GND FOR BLACK

GND. FOR VAR APL

S9285 WHITE

S9285 BLACK

S9275 FLAT FIELD

P4590-4

P2090-7

P428-8

P3960

R3830 51K

APL

BOUNCE GEN.

Q3890

Q3880

Q3780

R3791 3.3M

C3881 6.8uF 15V

R3793 3.3M

R3795 7.5K

CR3881

U3858 7474

U3835C 7400

U3735D 7400N

U3835D 7400

U3735C 7400

U3835B 7400

R3961 4.7K

R3840 4.7K

R3625 1K

CR3923

CR3913

CR3920

Q3920

R3911 1K

R3916 1K

R3913 5.23K

CR3921

CR3911

Q3825

Q3820

Q3720

CR3823

CR3821

CR3723

CR3721

CR3725

CR3811

CR3711

R3814 10

R3813 30.9K

R3811 5.11K

R3711 5.23K

-15V

+0.6V

+5V

CR3413

CR3411

Q3420

R3411 100

R3337 56.2K

R3420 20K

R3411 28.0K

R3410 10K

LINEARITY MOD. AMPLITUDE

P3400

140 mV

SUB-CARRIER

280 mV

P3800

P7101-4

R9290 0-15% BLACK

S9250

R9285 85-100% WHITE

S9290 % PEAK WHITE

(APL)

P4930-7

P3890

P3930

FIELD SQ WAVE

H BLANKING

FIELD SQUARE WAVE

17/330 STAIRCASE ENABLE

P2090-8

P1090-4

P8090-8

P3960

P2890-1

U3585B 7474

U3585A 7474

U3735B 7400

U3735A 7400

R3491 4.7K

R3513 5.1K

WINDOW

CONTROL LOGIC

S9253 10 STEP

S9253 5 STEP

S9253 RAMP

R3995 4.7K

R3993 4.7K

R3997 4.7K

GND FOR 10 STEPS

GND FOR 5 STEPS

GND. FOR RAMP

10 STEP TIMING

17/330 STEP TIMING

LIN. ENABLE

RAMP TIMING

P2800-7

P2890-2

P2890-6

P4960-2

P2890-5

P2290-5

U3875C 7402

U3875B 7402

U3875A 7402

U3875D 7402

U3755C 7404

U3855A 7474

U3755B 7404

U3755E 7404

U3775A 7400

U3775C 7400

U3755A 7404

U3775D 7400

U3775B 7400

U3755D 7404

U3835A 7400

5 STEP (REVERSE FOR RAMP)

P3760

TP3470

TP3660

TP3640

TP3420

R3581 15K

R3481 2.7K

R3451 100K

C3491 0.1

C3461 70

C3470 2.4-24.5

R3453 330

CR3451

Q3470

Q3450

Q3580

10 STEP DRIVE

R3661 2.7K

R3583 15K

R3585 1.8K

R3555 100K

C3565 2.4-29.5

C3473 150

CR3551

R3557 330

Q3545

5 STEP DRIVE

R3663 2.7K

R3616 20K

R3621 36.5K

R3641 12.1K

CR3651

CR3641

CR3653

Q3645

C3651 .02

C3551 .02

C3601 1uF

R3623 10 (SEL)

R3553 10K

RAMP AMPL

RAMP

5 STEP

INTEGRATOR

C3443 390

R3431 7.5K

R3515 5.6K

R3531 56K

CR3533

R3517 3.9K

R3610 47

CR3531

Q3520 10 STEP AMPL.

Q3510

Q3600

Q3540

Q3430

Q3440

Q3530

R3450 7.5K

R3521 15K

C3421 10

C3431 1uF 50V

R3523 10

R3511 1.74K

R3713 1K

Q3610

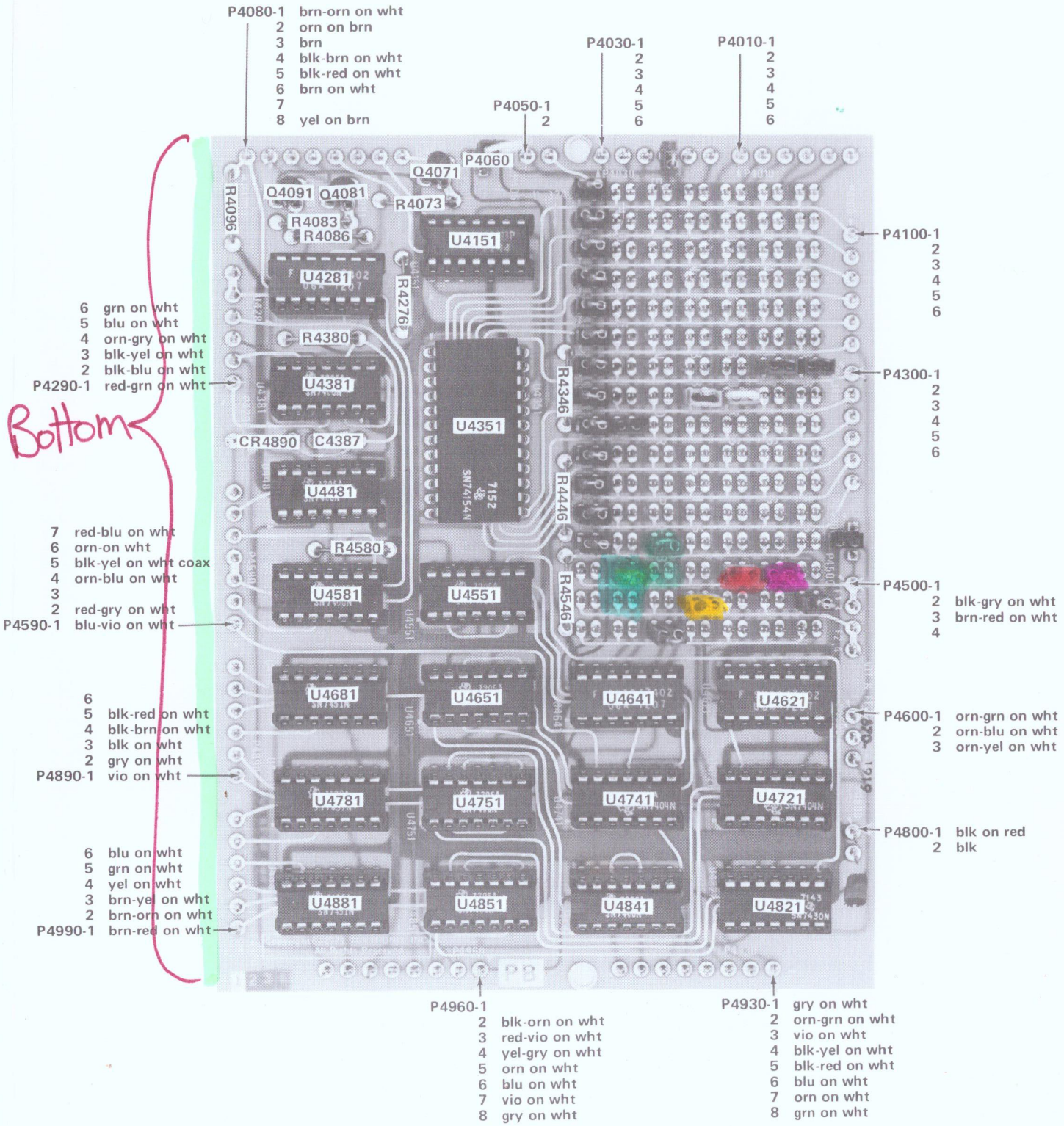
C3711 0.1

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. ALL IC'S: PIN 7 IS GROUNDED PIN 14 IS VCC, +5V

STAIRCASE and APL 3b M/MEB

REV. C, JAN. 1976

4000



A4 — ITS & FF circuit board

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. U4151:
   PIN 10 IS GROUNDED
   PIN 5 IS VCC, +5V
3. U4351:
   PIN 12 IS GROUNDED
   PIN 24 IS VCC, +5V
4. ALL OTHER IC'S:
   PIN 7 IS GROUNDED
   PIN 14 IS VCC, +5V

† P4010 † P4030 NOT USED

* PIN 2 CONNECTS TO PIN 1, 3 OR 4

ITS LINE & FIELD MATRIX

P4100 P4300 P4500 P4060* P9802 P4800 P4080

P1690-2 P1690-1

OFF F1-3 F2-4 ALL FIELDS

LINE 324 325 326 327 328 329 330 331 332 333 334 335

MULTI BURST

EXT LINE OR P+B

NOISE

ERASE OR EXT

P4010† P4030† P4050

U4621C 7402 U4721D 7404
U4621D U4721C
U4621B U4721E
U4621A U4721F
U4641C U4721B
U4641D U4721A
U4641A U4741C

+5V R4346 18K R4446 18K R4096 18K

U4281C 7402 R4086 3.3K Q4091
U4281D 7402 R4083 3.3K Q4081
R4073 3.3K Q4071

INDICATOR LOGIC

PREVIEW PROGRAM BYPASS

U4821 7430 U4551C 7400
U4741D 7404 U4551D 7400
U4581C 7400

ITS KEY

P4590 P591-3 P9646-8 P9646-7 P9646-6 P4600 P4400*

U4481A 7400

NOISE LOGIC

R4546 4.7K

U4351 74154 A B C D G2 G1

U4381B&C 7400

P4290 P1400-7 P4080 P2400-3

R4276 2.7K R4380 2.7K

ITS NONSYNCHRONOUS INHIBIT

U4151 7493 LINE COUNTER

P1090-9 P591-5 P691-8 P4590 P398-8 P4290 P1690-9 P1690-4 P4960 P498-3 P401-8 P461-3 P461-4 P4990 P4890 P4930 P4590 P4290

LOW FOR PREVIEW
HIGH FOR AUX
LOW FOR NONSYNC
CR4390
C4387 470
VERT. BLANKING
ITS H BLANKING
FULL FIELD ENABLE
MOD. VERT. BLANKING
ALT

AUX

U4481D 7400 U4381D 7400 U4381A 7400 U4481B 7400 U4581D 7400 U4481C 7400 R4580 1K U4281B 7402

ITS OR FULL FIELD

FULL FIELD LOGIC

LINE 330 LINE 17 LINE 331 MULTI BURST LINEARITY NOISE

U4881 7451 U4781 7451 U4681 7451

U4851B 7400 U4851C 7400 U4751B 7400 U4751C 7400 U4651C 7400 U4551B 7400 U4651B 7400 U4741F 7404

U4851A 7400 U4851D 7400 U4751A 7400 U4751D 7400 U4651D 7400 U4551A 7400 U4651A 7400 U4641B 7402 U4741E 7404 U4741B 7404 U4741A 7404

17 ENABLE
17/330 ENABLE
MOD. INHIBIT
MOD. PULSE Ø
M.B. ENABLE
M.B. WIDTH ENABLE
331 ENABLE
LIN. ENABLE
NOISE KEY OUT
PED AND NOISE ENABLE
BAR ENABLE
PULSE ENABLE

U4841C 7400 U4841D U4841B 7400 U4841A 7400

CONTROL LOGIC

U4581A 7400 U4581B 7400

HIGH FOR WINDOW
H. BLANKING
LOW FOR WINDOW

P4960 P6951-6 P2900-1 P4930 P8090-4 P4960 P3930-6 P8200-3 P4590 P4290 P6603-1 P7691-8 P4930 P2900-4 P2900-6 P4590 P2090-5 P4290 S9225 P4930 P498-4 P2900-7 P8090-2 P8200-1

A4 ITS &FF CIRCUIT BOARD

ITS & FULL FIELD LOGIC 4 MEB

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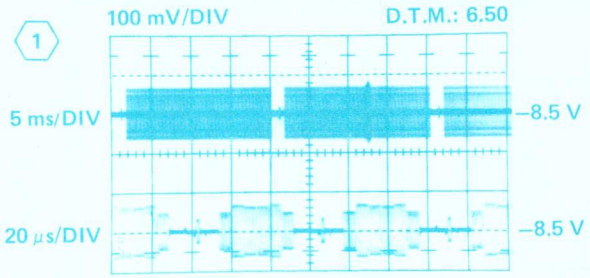
ITS & FULL FIELD LOGIC 4

1



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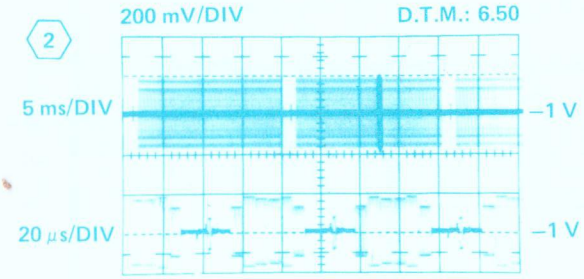

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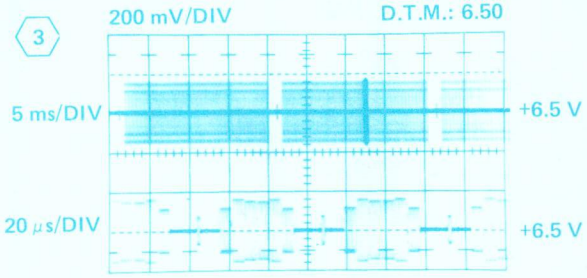

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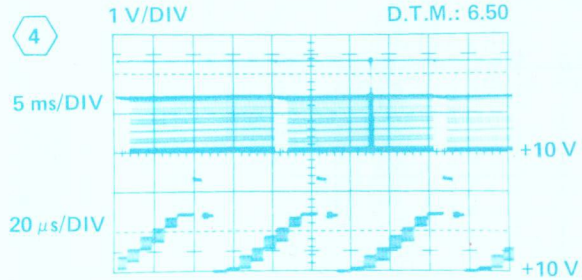

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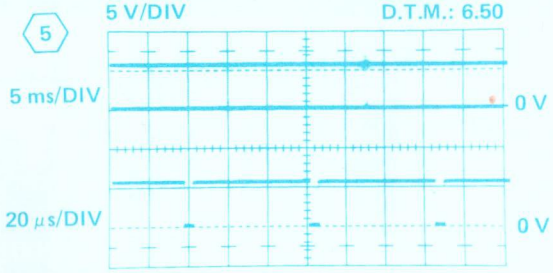

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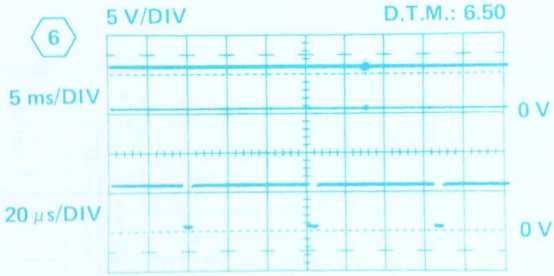

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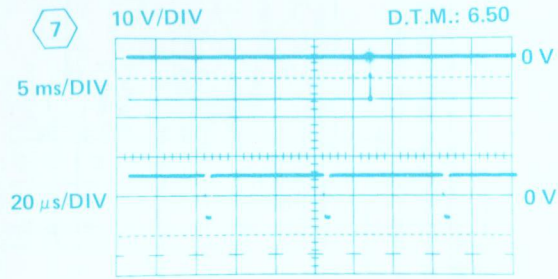

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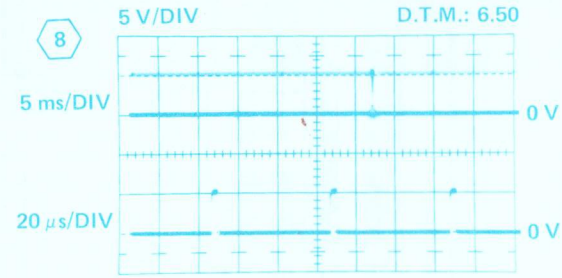
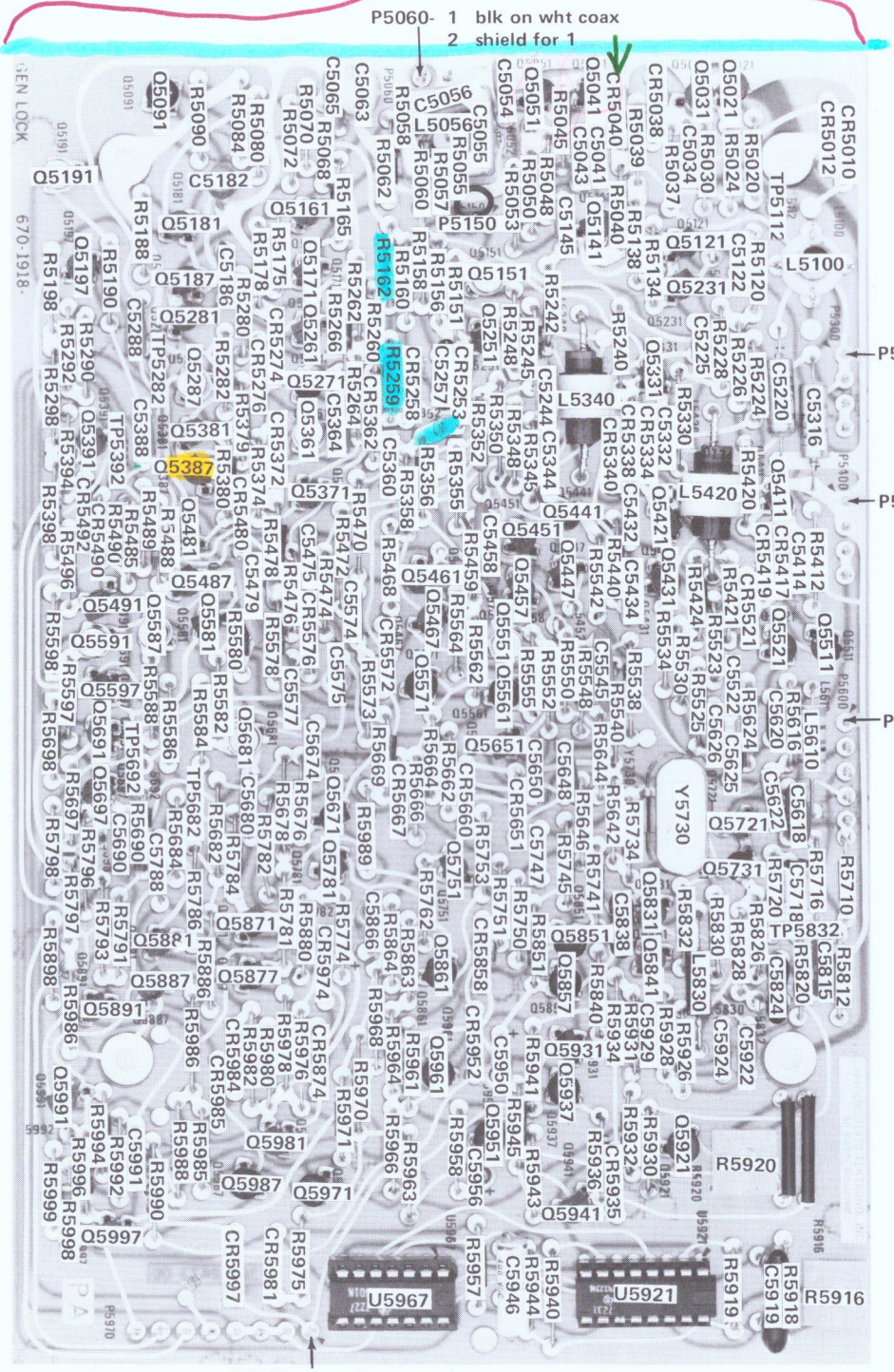


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

5000 Bottom



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A5 — GEN LOCK circuit board

NOTES:
1. ✳ INDICATES PARTS LOCATED IN SHIELD CAN.
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
3. U5921 PIN 8 & U5967 PIN 7 ARE GROUNDED
4. U5921 PIN 16 & U5967 PIN 14 ARE VCC, +5V

CHROMA AMP

SUBCARRIER PHASE

SOUND INHIBIT

SYNC SEPARATOR

SOUND IN SYNCS INHIBIT

BACK PORCH GENERATOR

bad I.C. socket? bad I.C.

wrong

pin 9 & 12 wrong

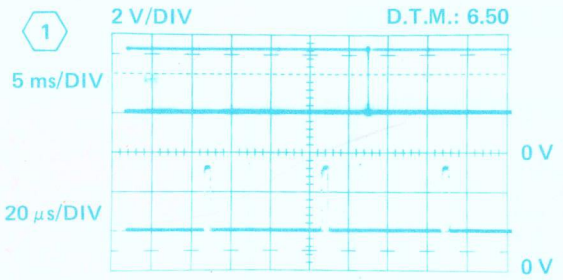
9-12-14 wrong

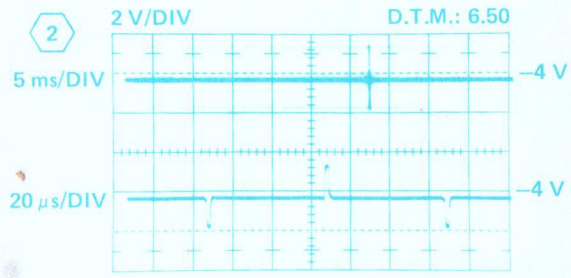
P/O A5 GEN LOCK CIRCUIT BOARD

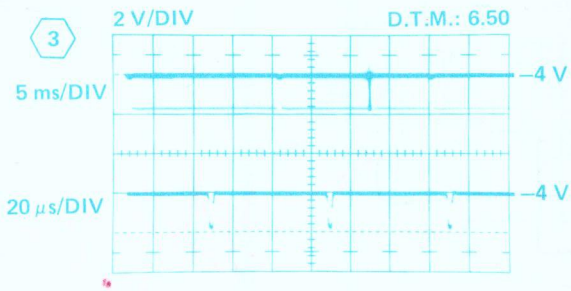
SYNC STRIP & CHROMA AMP ⑤a

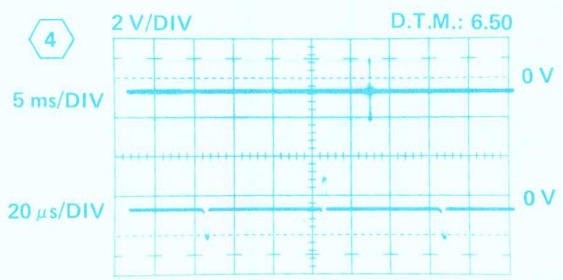
SYNC STRIP & CHROMA AMP
& CHROMA AMP ⑤a

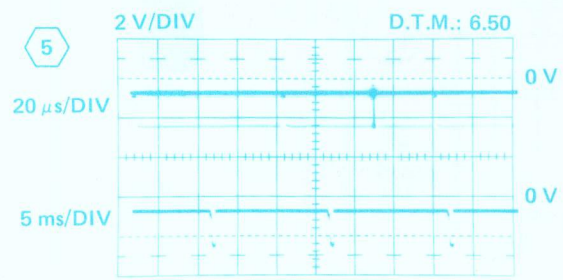
DAJ/MEB

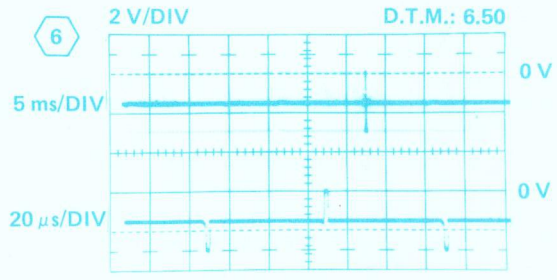


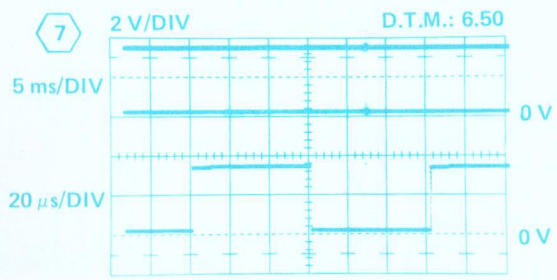


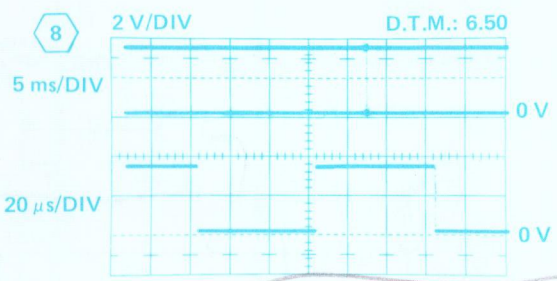


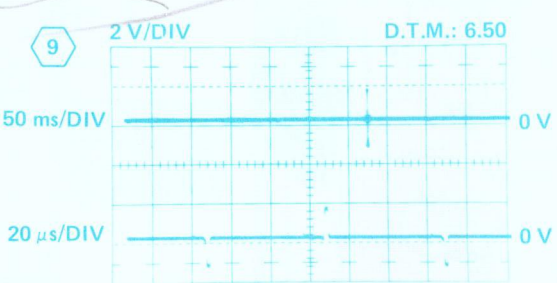


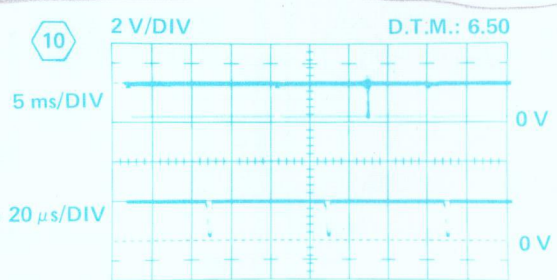




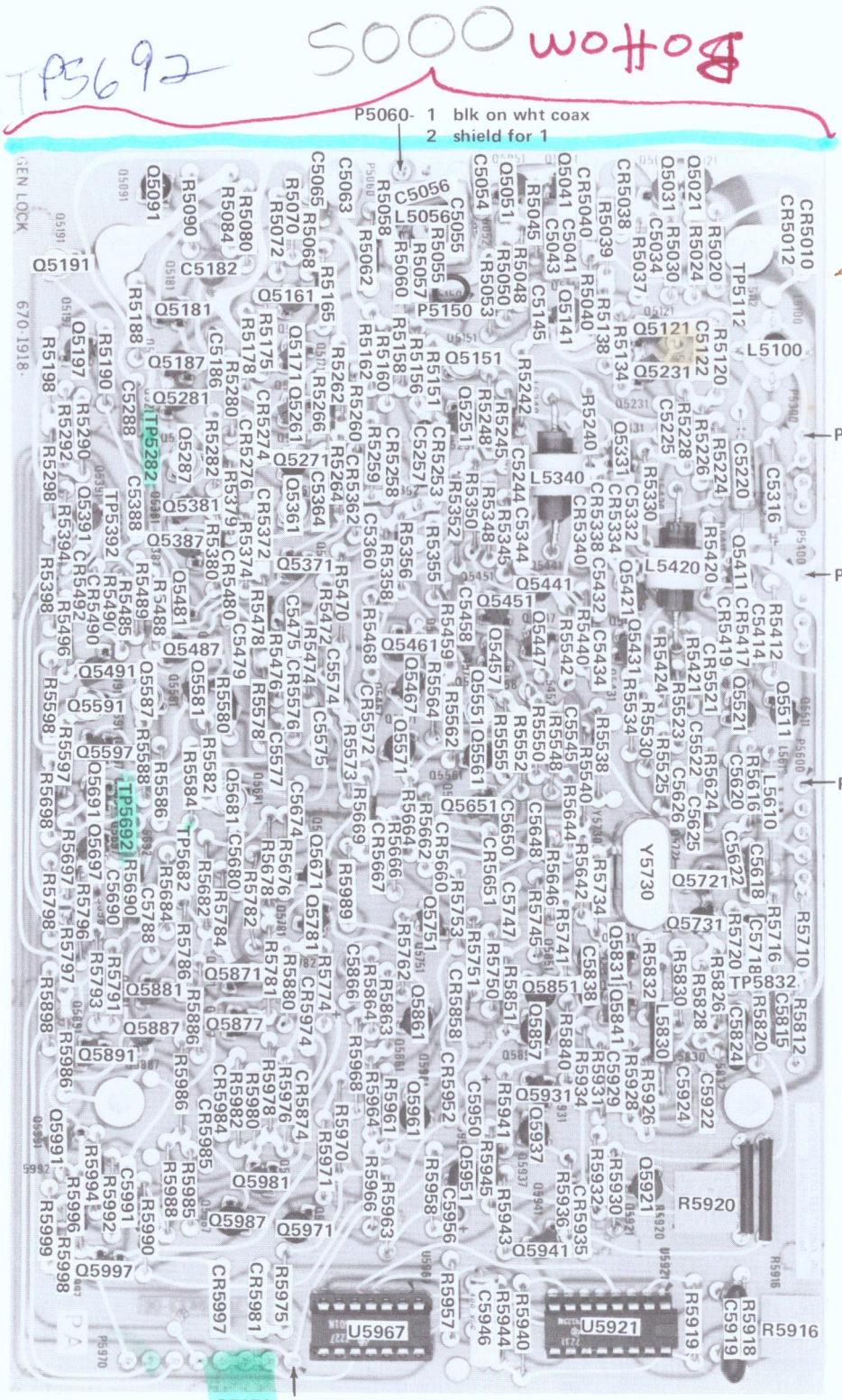








Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.



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A5 — GEN LOCK circuit board

NOTE:
SEE PARTS LIST FOR
SEMICONDUCTOR TYPES

WAVEFORMS

CW SUBCARRIER ⑨

P298-5

P5600

P8100-5 ⑧

P8100-6 ⑧

P5970

P5970

DEMODULATOR DRIVER

BURST RECTIFIERS

PAL SWITCHER

DEMODULATORS

BACK PORCH CLAMPS

V BURST CLAMP

U BURST CLAMP

BURST LOCK DISABLE

PAL PRESET

Q5231 ⑤a CHROMA

Q5251 ⑤a BACK PORCH GATE

DEMODULATOR ENABLE

P5300

P5400

P5970

P9852 ⑪

P9832 ⑪

P9802 ⑪

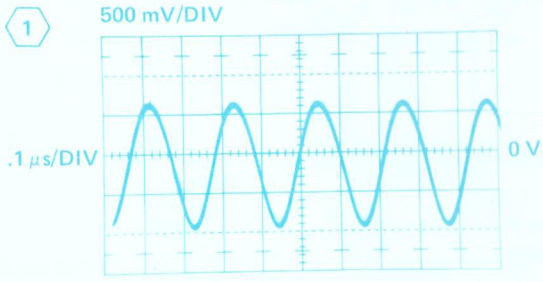
P398-7 ⑨a

P8600-3 ⑧

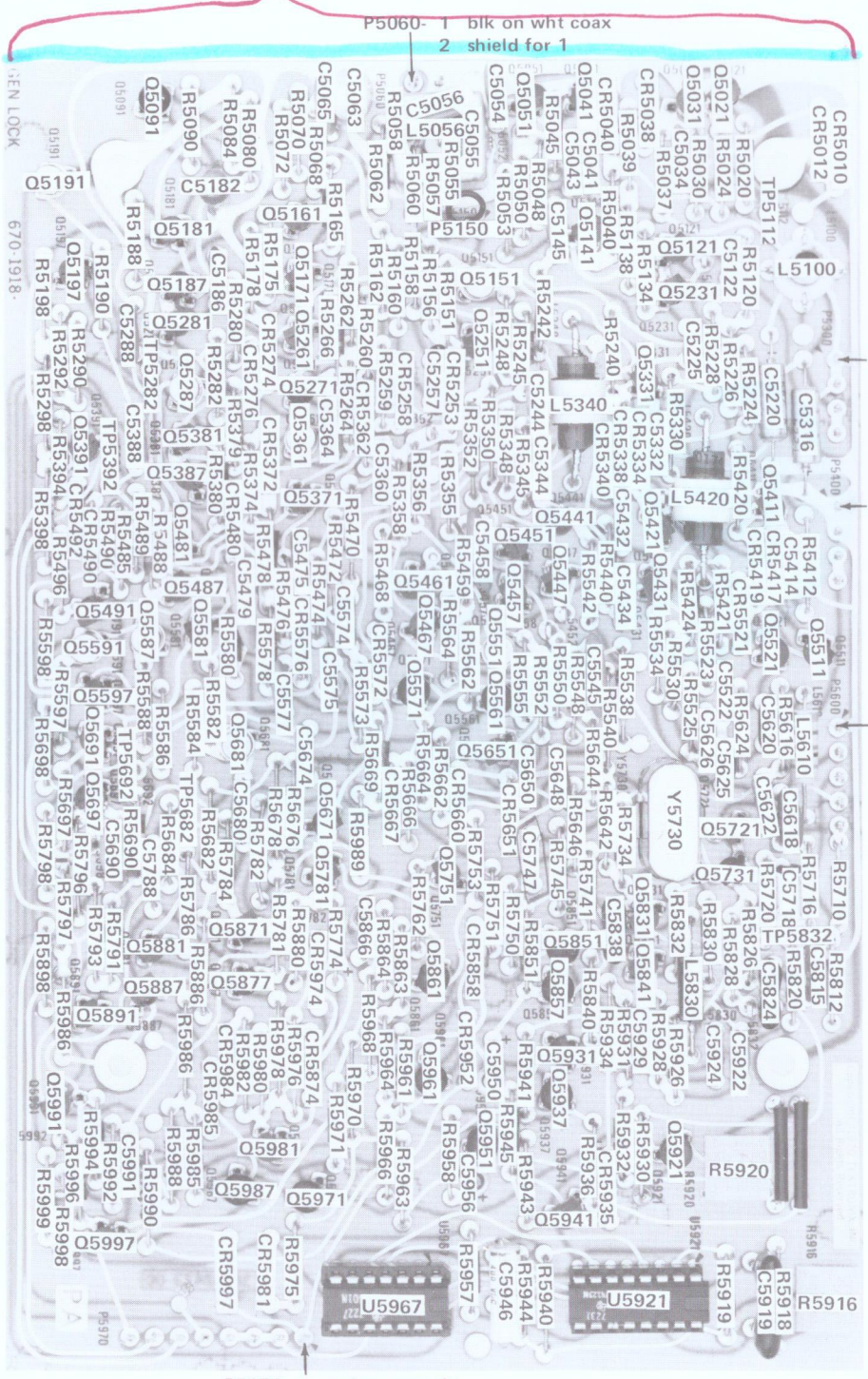
TO R5684 ⑤c

TO R5784 R5751 ⑤c

P/O A5 GEN LOCK CIRCUIT BOARD



Voltage and Waveform obtained under conditions given on back side of Section 7 Title page except test oscilloscope internally triggered.



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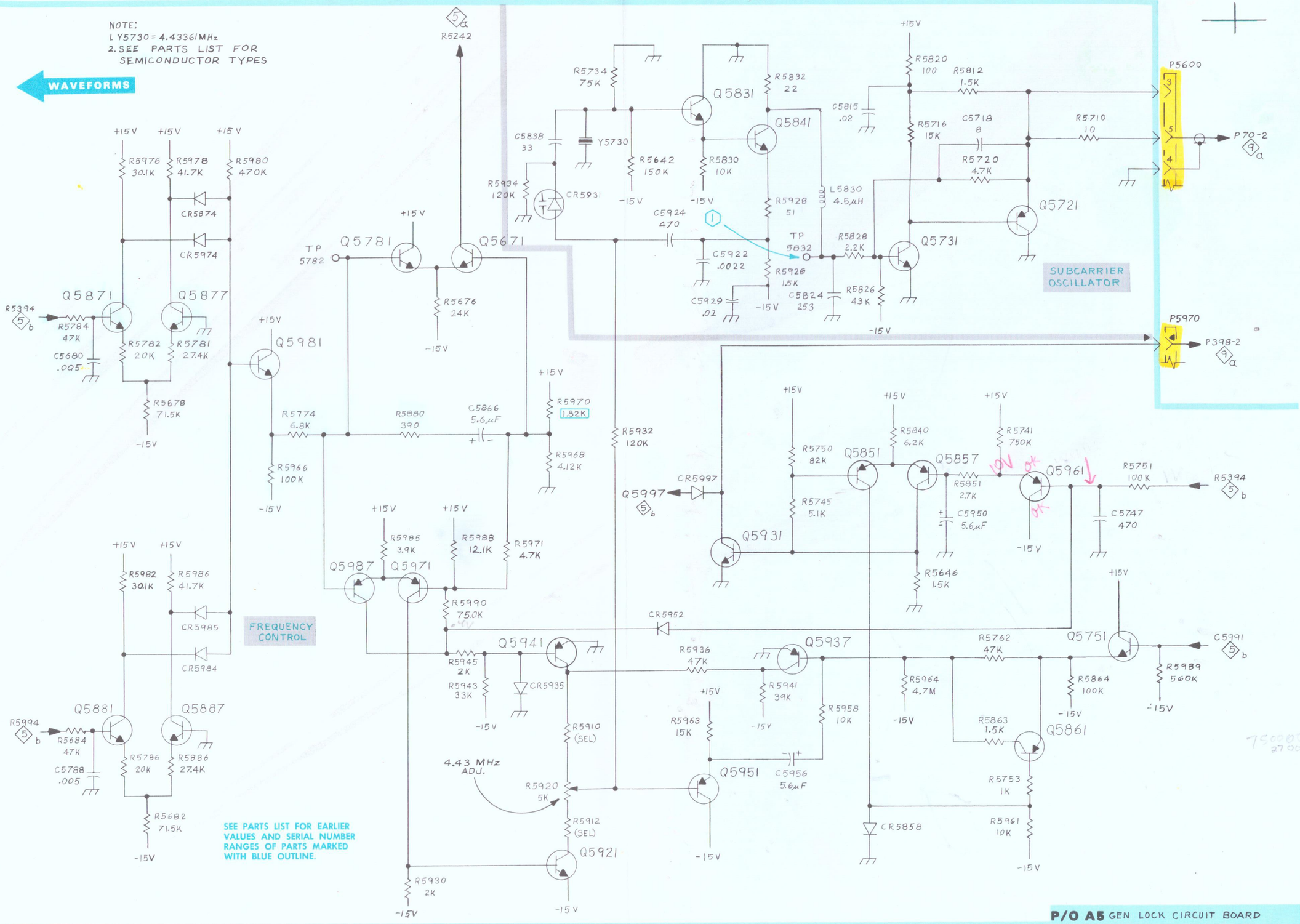
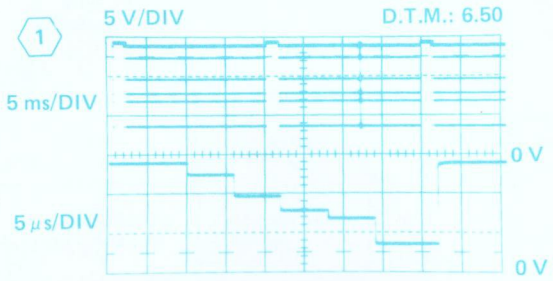
A5 — GEN LOCK circuit board

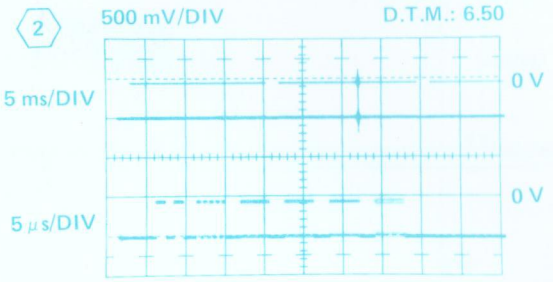
NOTE:
1. Y5730 = 4.43361MHz
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

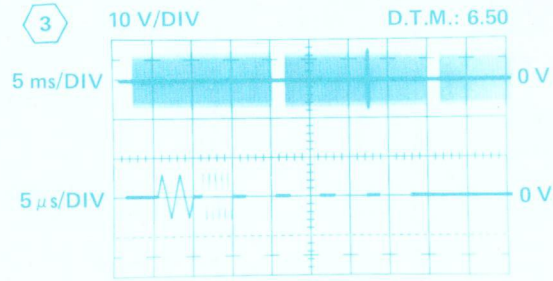
WAVEFORMS



P/O A5 GEN LOCK CIRCUIT BOARD







Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except FULL FIELD SIG switch set to MULTIBURST.

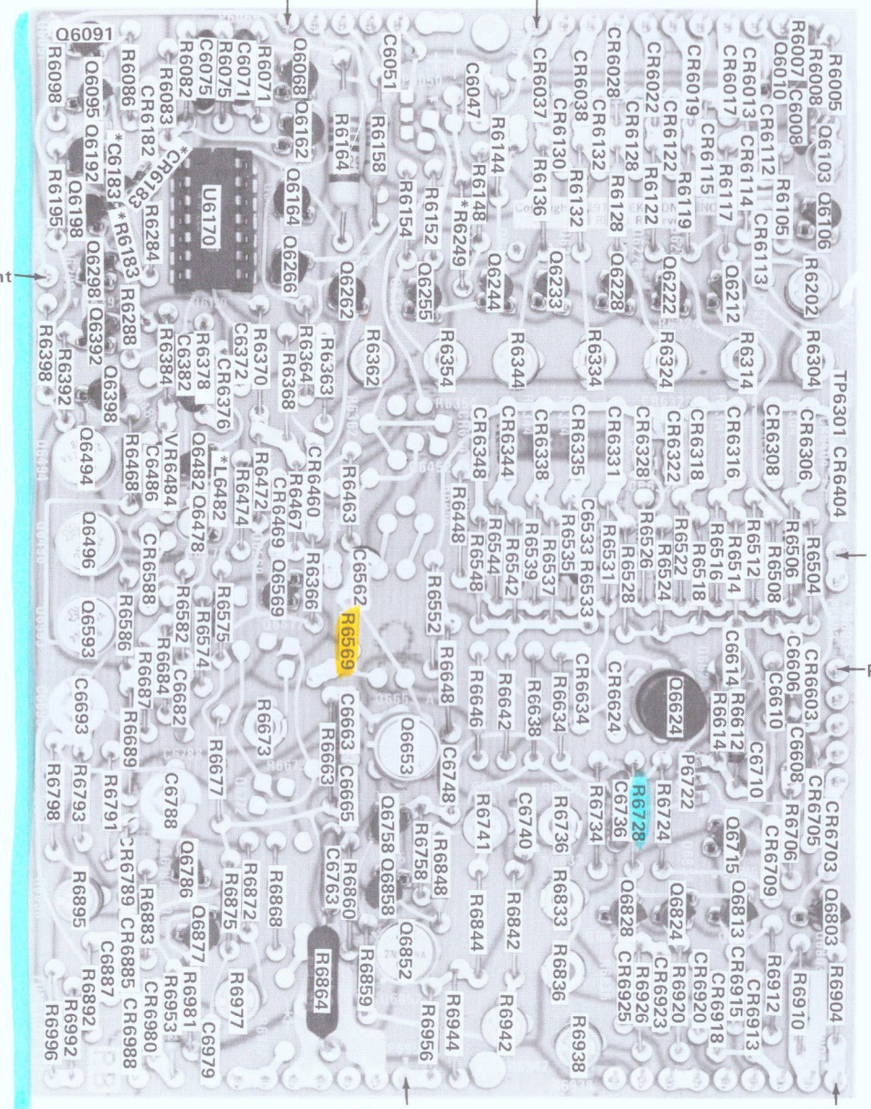
if step 13 bad check for 5.23.1K

6000

P6035-1
- 2 blk-gry on wht
- 3 blk-vio on wht
- 4 brn-orn on wht
- 5 brn-red on wht
- 6 blk-grn on wht
- 7
- 8 blk-blu on wht
- 9 violet on wht
- 10 blk-yel on wht

P6069-1 blk on vio
- 2 blk
- 3 brn on red
- 4
- 5 blk on red
- 6

P6299- 1 blu on wht



P6502- 1 blk
- 2

P6603-1 blu on wht
- 2 grn on wht coax
- 3 yel-blu on wht
- 4
- 5

P6951- 1 yel on wht coax
- 2 shield for 1
- 3
- 4 blk
- 5 blk-yel on wht
- 6 blk-yel on wht
- 7 yel-gry on wht

P6904-1 orn-vio on wht
- 2 yel-vio on wht
- 3 blk-blu on wht
- 4 blk-red on wht
- 5 blk-orn on wht
- 6 red-yel on wht
- 7
- 8 gry on wht
- 9 orn-yel on wht

*See Parts List for serial number ranges.

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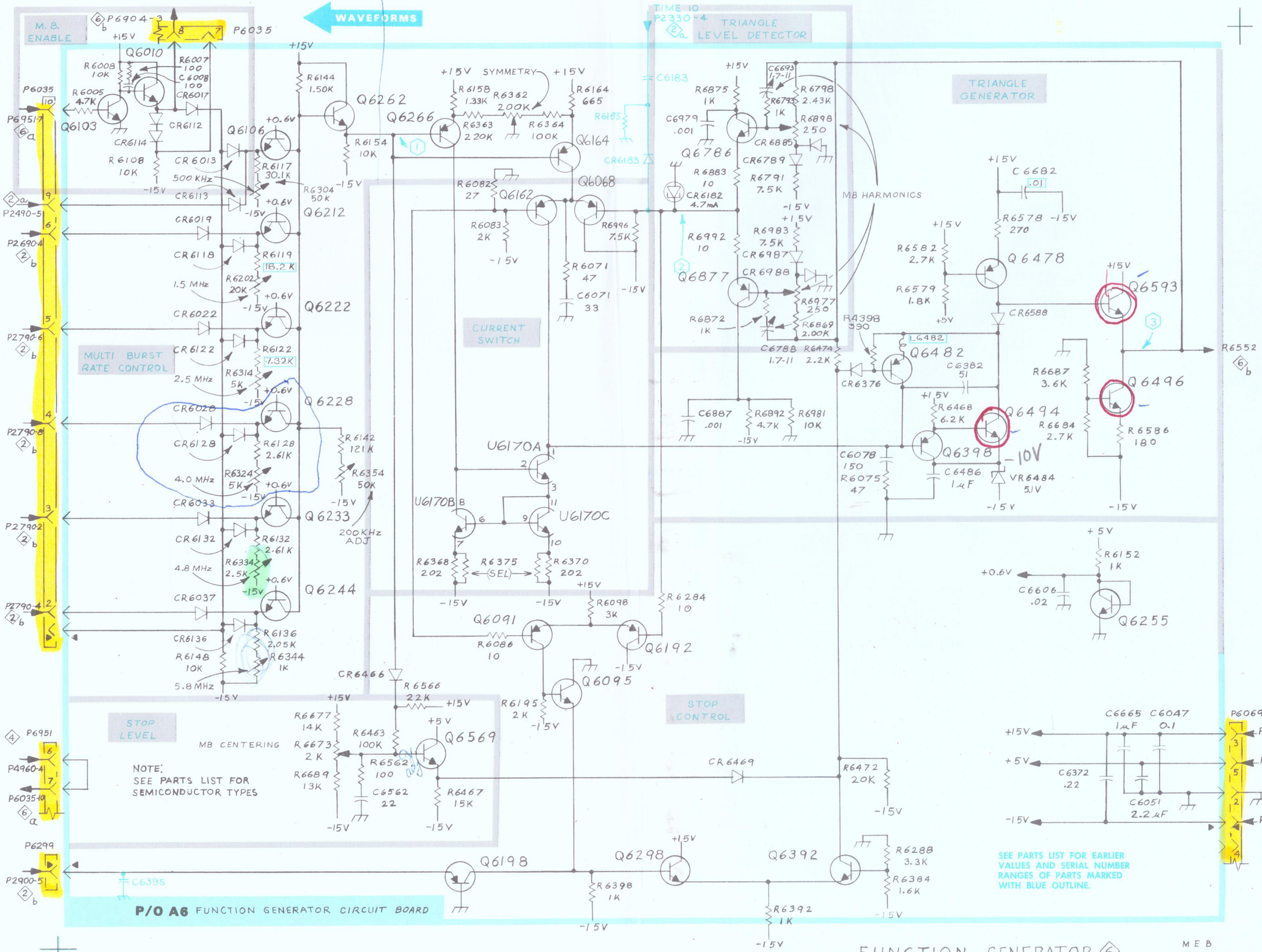
A6 – FUNCTION GENERATOR circuit board

FUNCTION GENERATOR 6a



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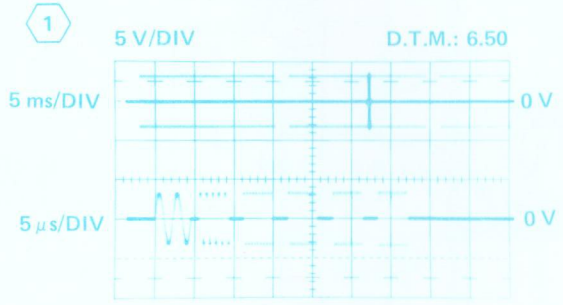
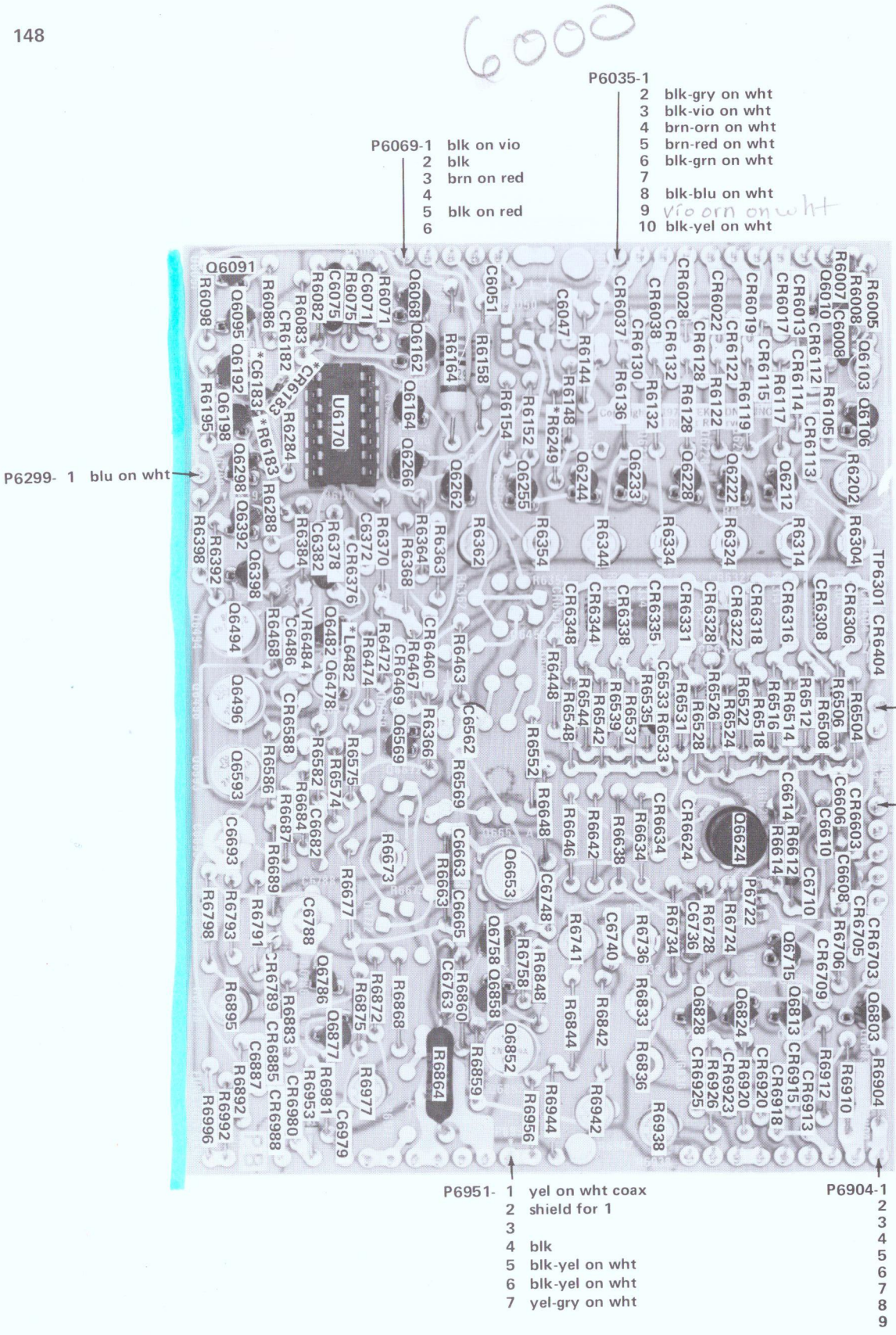
FUNCTION GENERATOR 6a

M E B

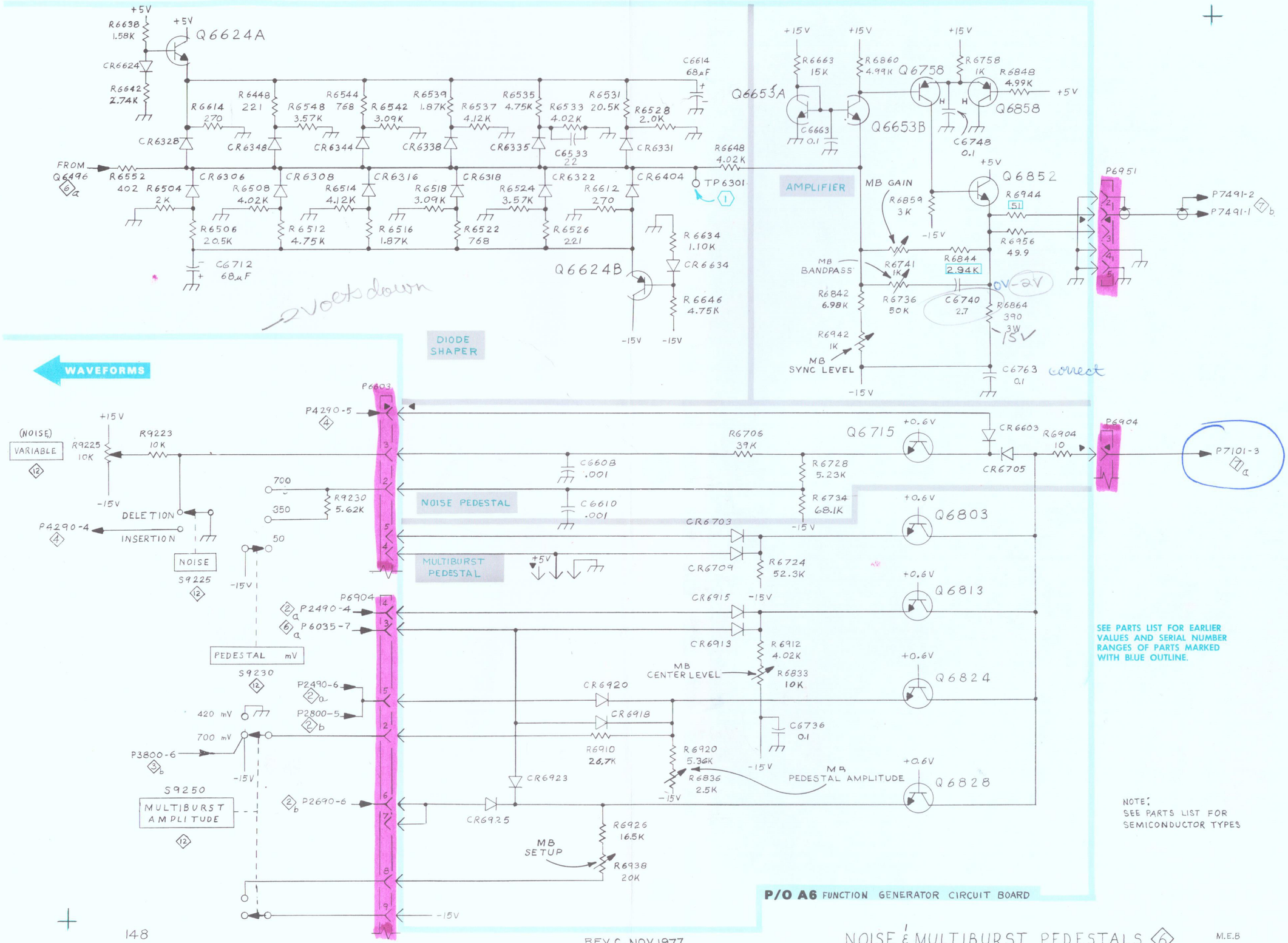


Voltage and Waveform obtained under conditions given on back side of Section 7 Title page except FULL FIELD SIG switch set to MULTIBURST.



*See Parts List for serial number ranges.

A6 — FUNCTION GENERATOR circuit board



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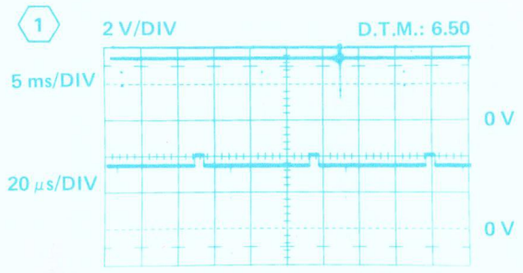
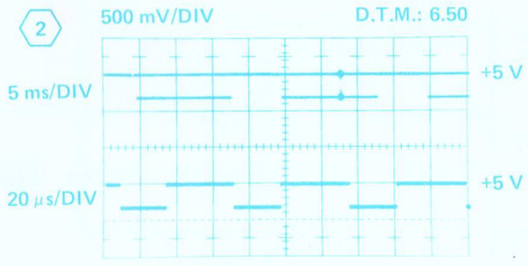
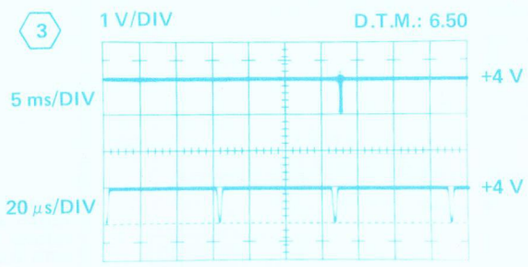
NOISE & MULTIBURST PEDESTALS 6b M.E.B

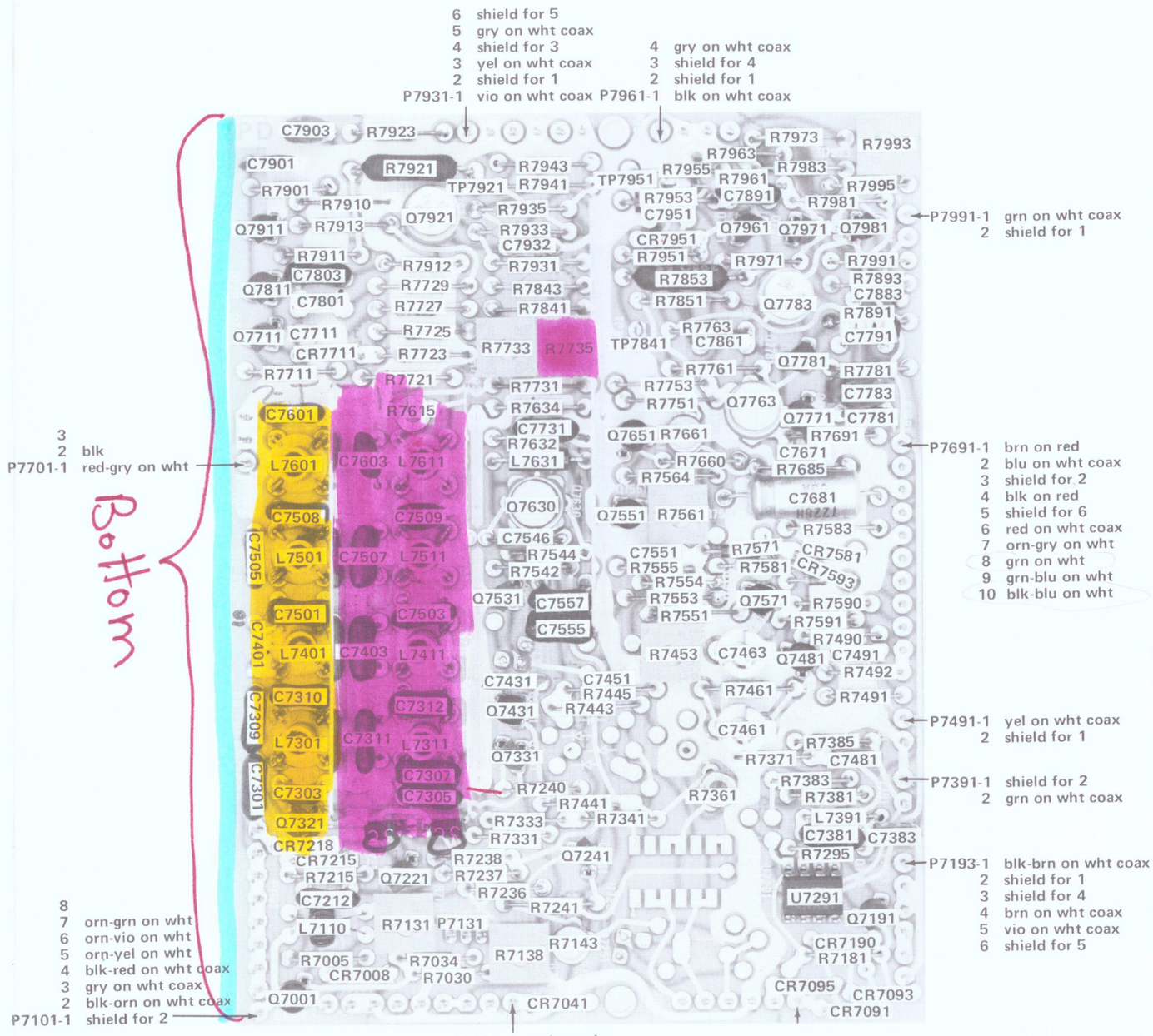






Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

7060



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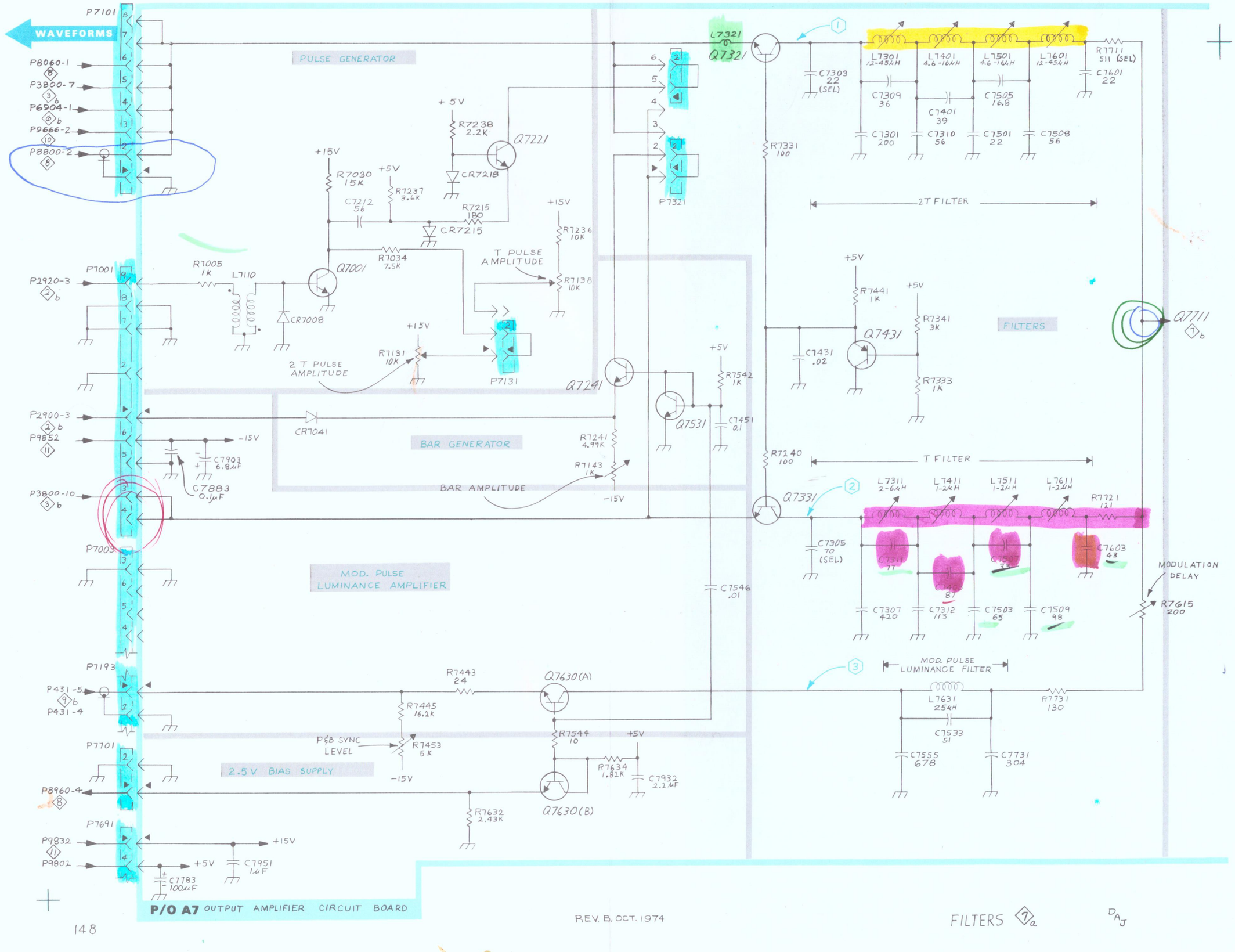
FILTERS



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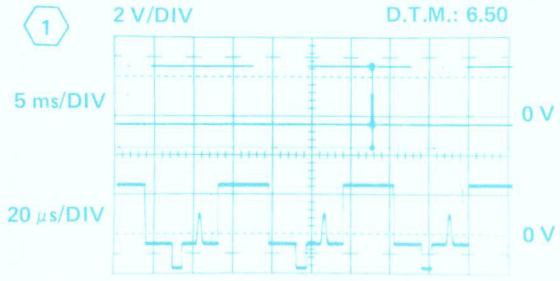
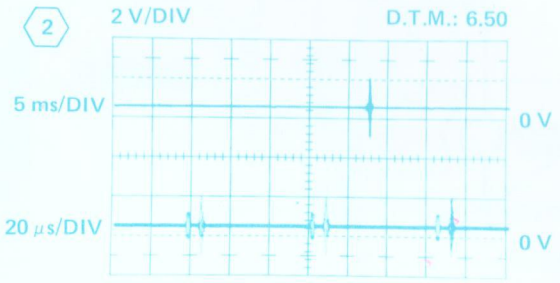
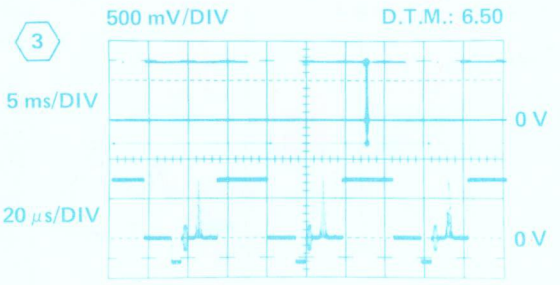
FILTERS 7a DAJ

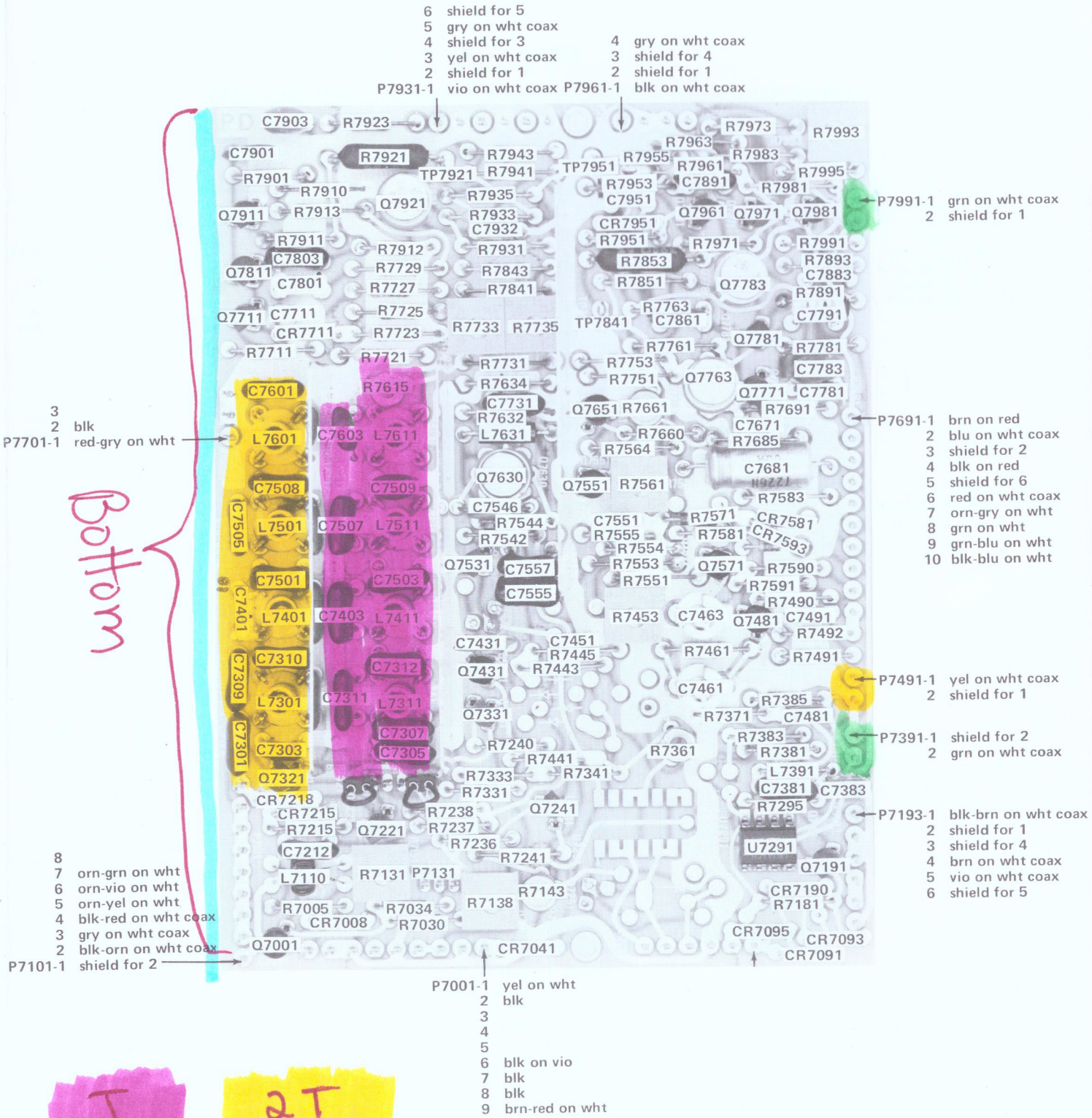






Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

7000



A7 – OUTPUT AMPLIFIER circuit board

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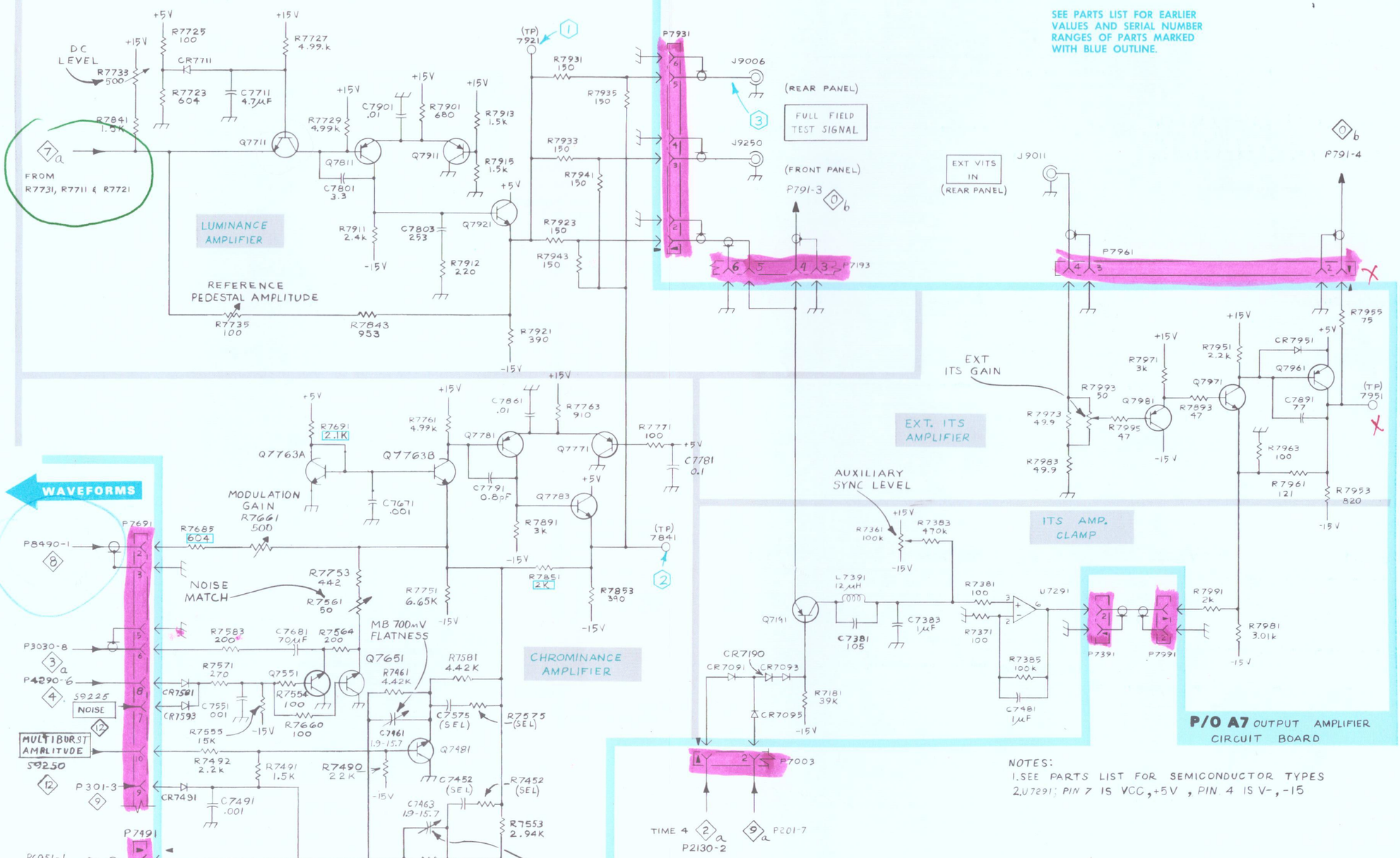
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.



NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. U7291; PIN 7 IS VCC, +5V, PIN 4 IS V-, -15

REV. B, OCT. 1974

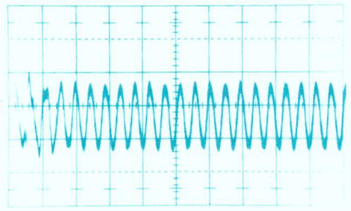
EBC

OUTPUT AMPLIFIERS 7b

WL RHL J. STORY

⟨1⟩ 20 mV/DIV

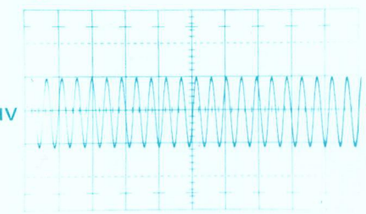
.5 μs/DIV



–200 mV

⟨2⟩ 500 mV/DIV

.5 μs/DIV



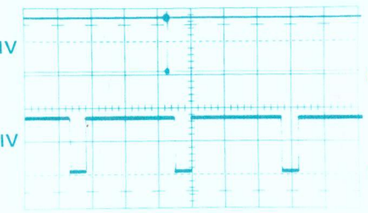
0 V

⟨3⟩ 2 V/DIV D.T.M.: 4:30

5 ms/DIV

0 V

20 μs/DIV



0 V

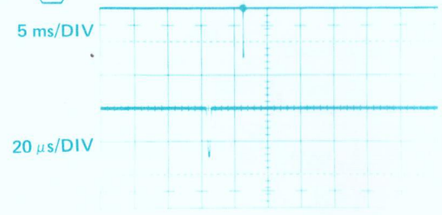
⟨4⟩ 500 mV/DIV D.T.M.: 4.30

+3 V

5 ms/DIV

+3 V

20 μs/DIV



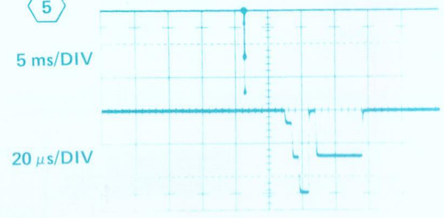
⟨5⟩ 500 mV/DIV D.T.M.: 4.30

+5 V

5 ms/DIV

+5 V

20 μs/DIV

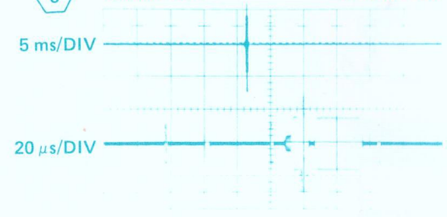


⟨6⟩ 500 mV/DIV D.T.M.: 4.30

5 ms/DIV

0 V

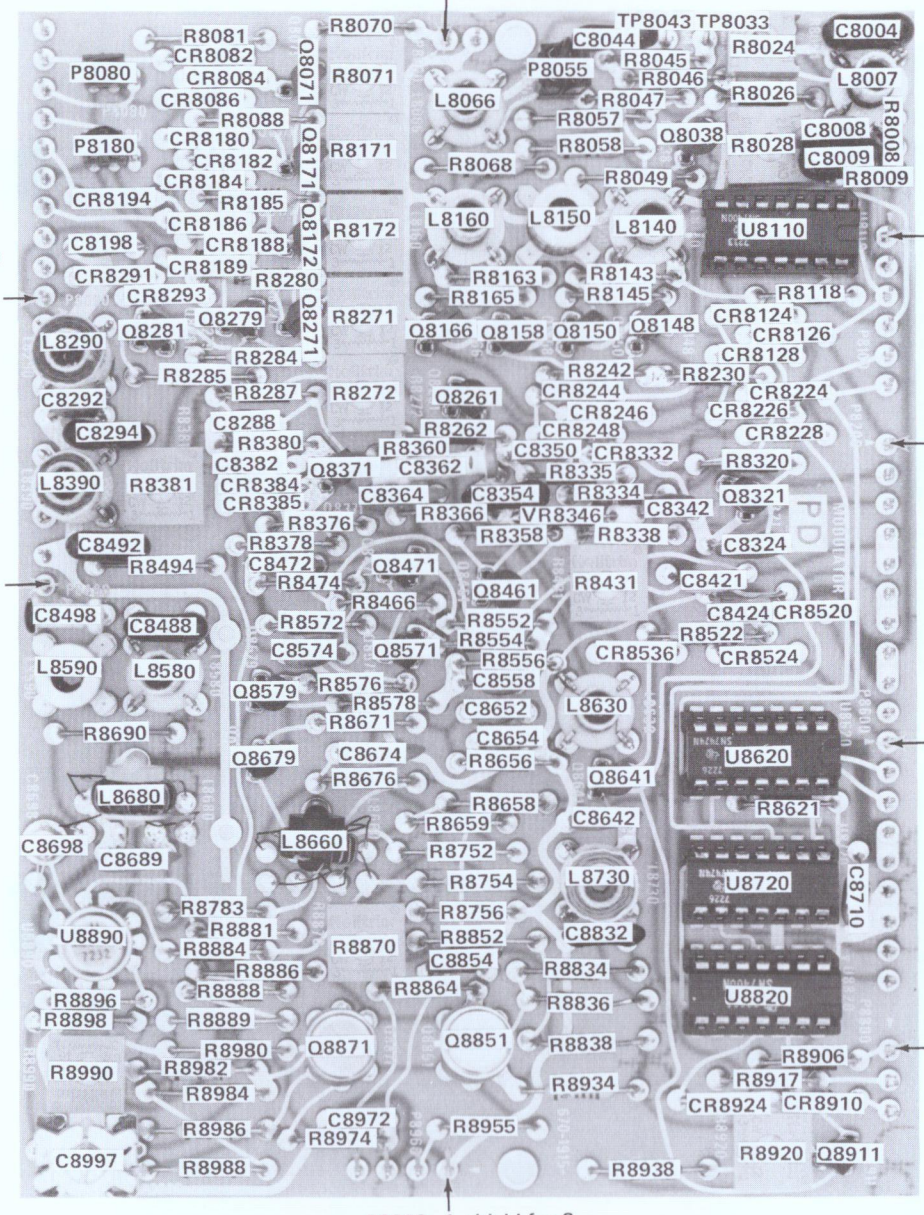
20 μs/DIV



0 V

Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except Waveforms ⟨1⟩ and ⟨2⟩ test oscilloscope internally triggered.

8000



A8 — MODULATOR circuit board below SN B050000.

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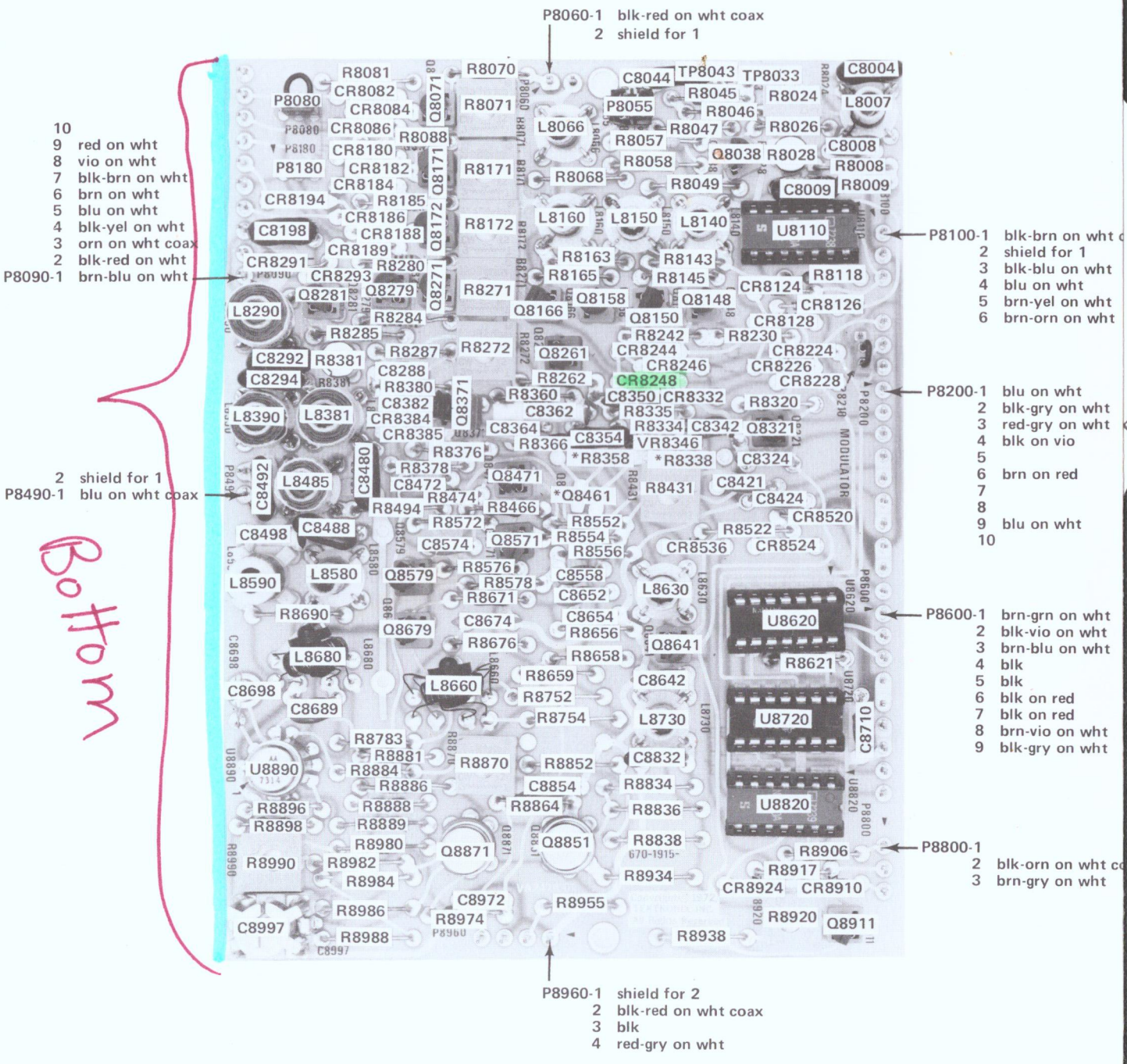
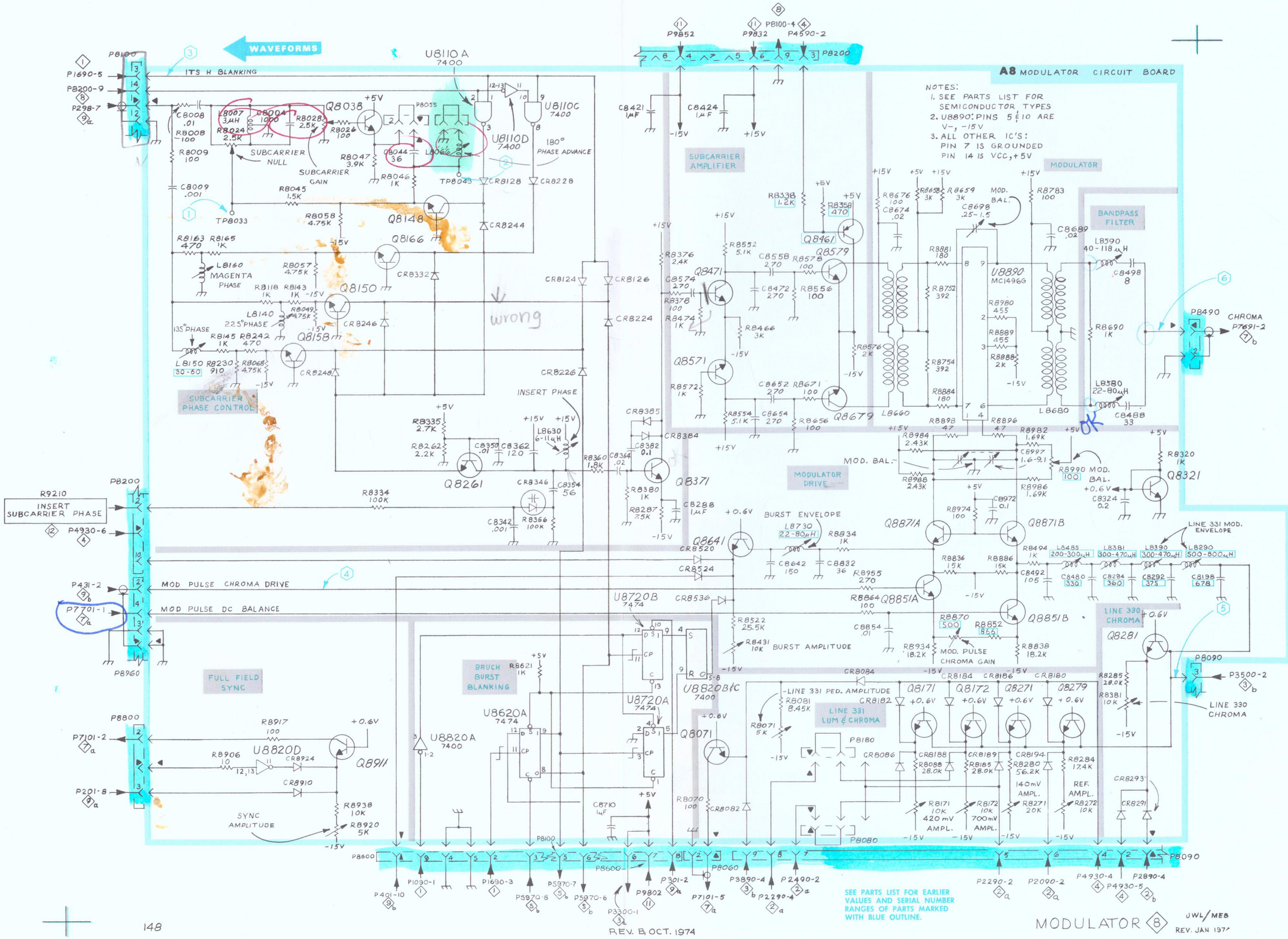
A8—MODULATOR circuit board below SN B050000

8000



A8 — MODULATOR circuit board SN B050000 and up.


A8 MODULATOR CIRCUIT BOARD
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. U8890: PINS 5 & 10 ARE V-, -15V
3. ALL OTHER IC'S: PIN 7 IS GROUNDED PIN 14 IS VCC, +5V
WAVEFORMS
ITS H BLANKING
U8110A 7400
U8110C 7400
U8110D 7400
Q8038
SUBCARRIER NULL
SUBCARRIER GAIN
180° PHASE ADVANCE
Q8148
Q8166
Q8150
Q8158
MAGENTA PHASE
135° PHASE
22.5° PHASE
SUBCARRIER PHASE CONTROL
wrong
INSERT PHASE
Q8261
INSERT SUBCARRIER PHASE
SUBCARRIER AMPLIFIER
MODULATOR
BANDPASS FILTER
MOD. BAL.
U8890 MC1496G
Q8461
Q8579
Q8471
Q8571
Q8679
MODULATOR DRIVE
MOD. BAL.
Q8321
Q8371
Q8641
BURST ENVELOPE
Q8871A
Q8871B
LINE 331 MOD. ENVELOPE
MOD PULSE CHROMA DRIVE
MOD PULSE DC BALANCE
U8720B 7474
U8720A 7474
U8820B&C 7400
U8820A 7400
U8620A 7474
U8820D 7400
BRUCH BURST BLANKING
FULL FIELD SYNC
BURST AMPLITUDE
MOD. PULSE CHROMA GAIN
Q8851A
Q8851B
LINE 330 CHROMA
Q8281
Q8071
Q8911
SYNC AMPLITUDE
-LINE 331 PED. AMPLITUDE
LINE 331 LUM & CHROMA
Q8171
Q8172
Q8271
Q8279
140mV AMPL.
420 mV AMPL.
700mV AMPL.
REF. AMPL.
CHROMA P7691-2
LINE 330 CHROMA
P8100
P8200
P8600
P8800
P8960
P8080
P8090
P8180
P8490
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
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MODULATOR 8
JWL/MEB
REV. JAN 1974
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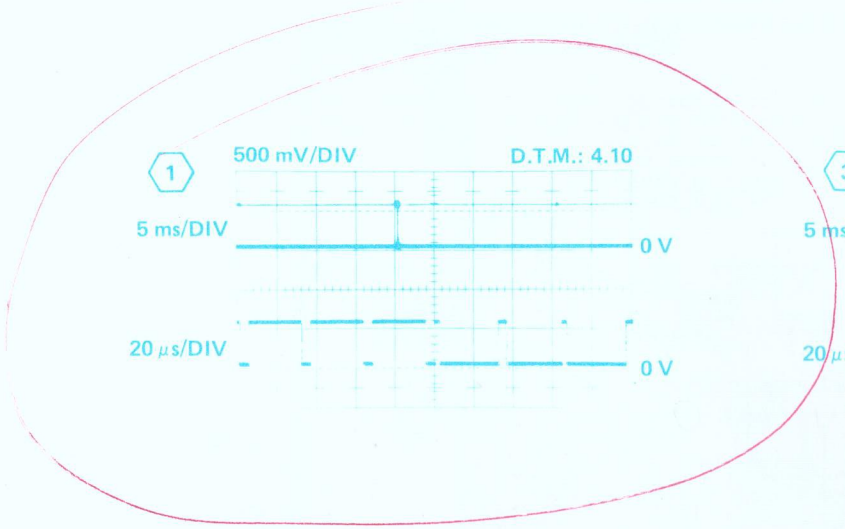
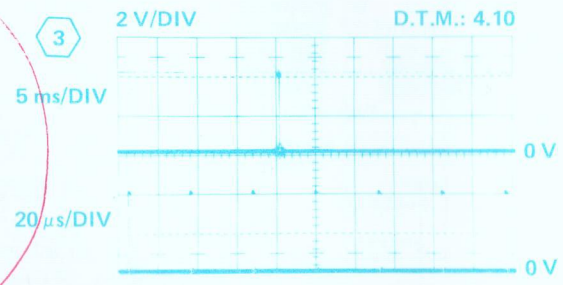
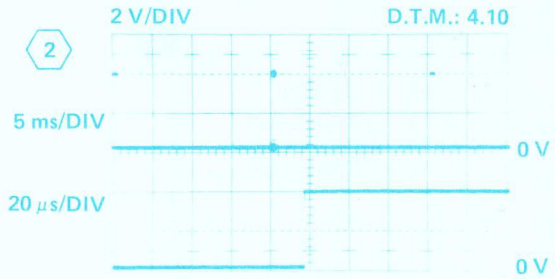
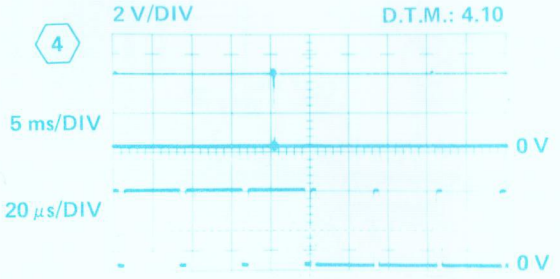
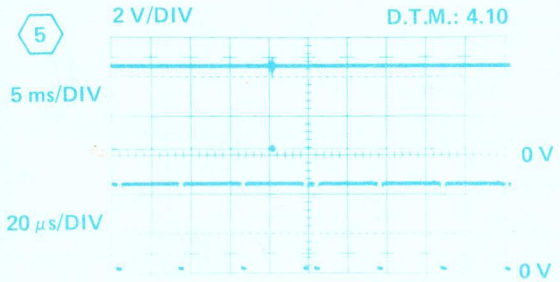
MODULATOR 8





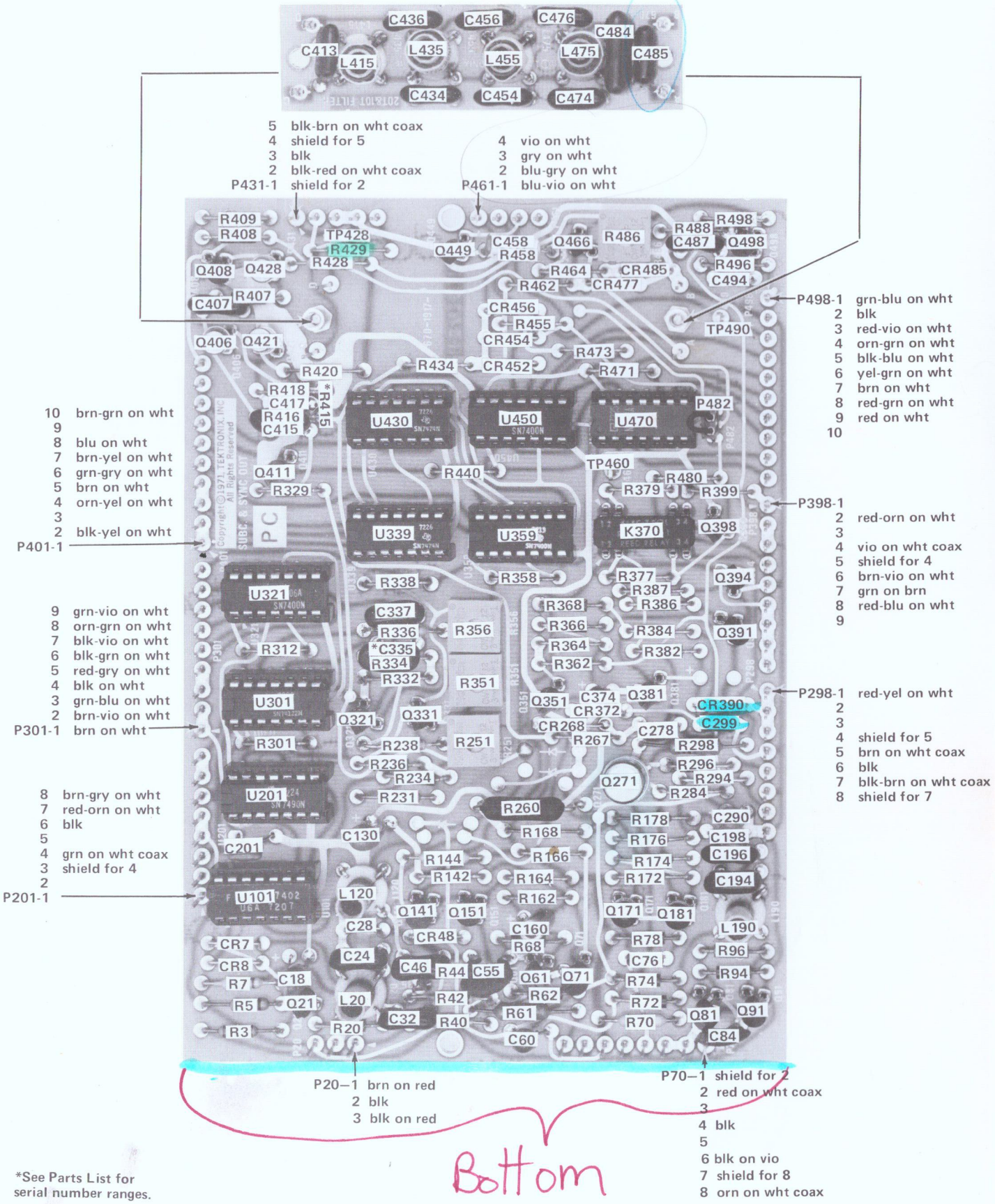






Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

0 – 500



A9 – SUBCARRIER & SYNC OUT circuit board

WAVEFORMS

COMP. SYNC AMP

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. U301: PIN 10 IS GROUNDED PIN 5 IS VCC, +5V
3. ALL OTHER IC'S: PIN 7 IS GROUNDED PIN 14 IS VCC, +5V

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.

COMP SYNC FILTER

SUBCARRIER AMPLITUDE

SUBCARRIER AMPLIFIER

EQUALIZER WIDTH

SERRATION WIDTH

SYNC WIDTH

VERT SYNC

HORIZ SYNC

REGENERATED SYNC TIMING

BURST KEY

NON SYNC INHIBIT

LOW FOR NON SYNC

P/O A9 SUBCARRIER & SYNC OUT CIRCUIT BOARD

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SYNC & SUBCARRIER OUTPUT AMPLIFIERS

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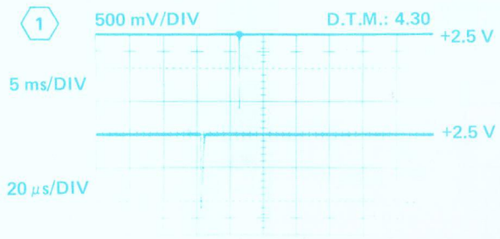
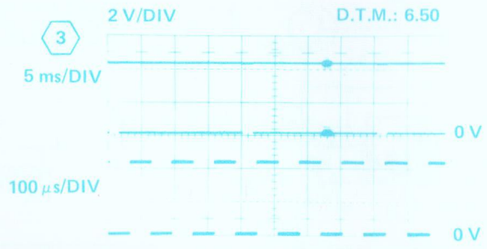
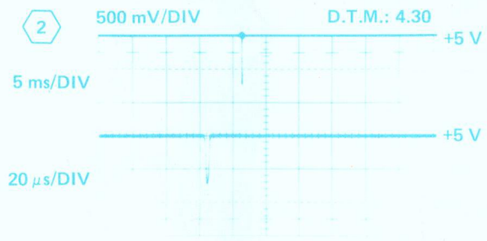
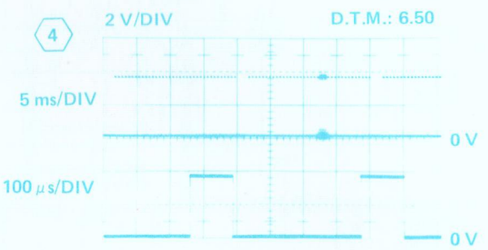


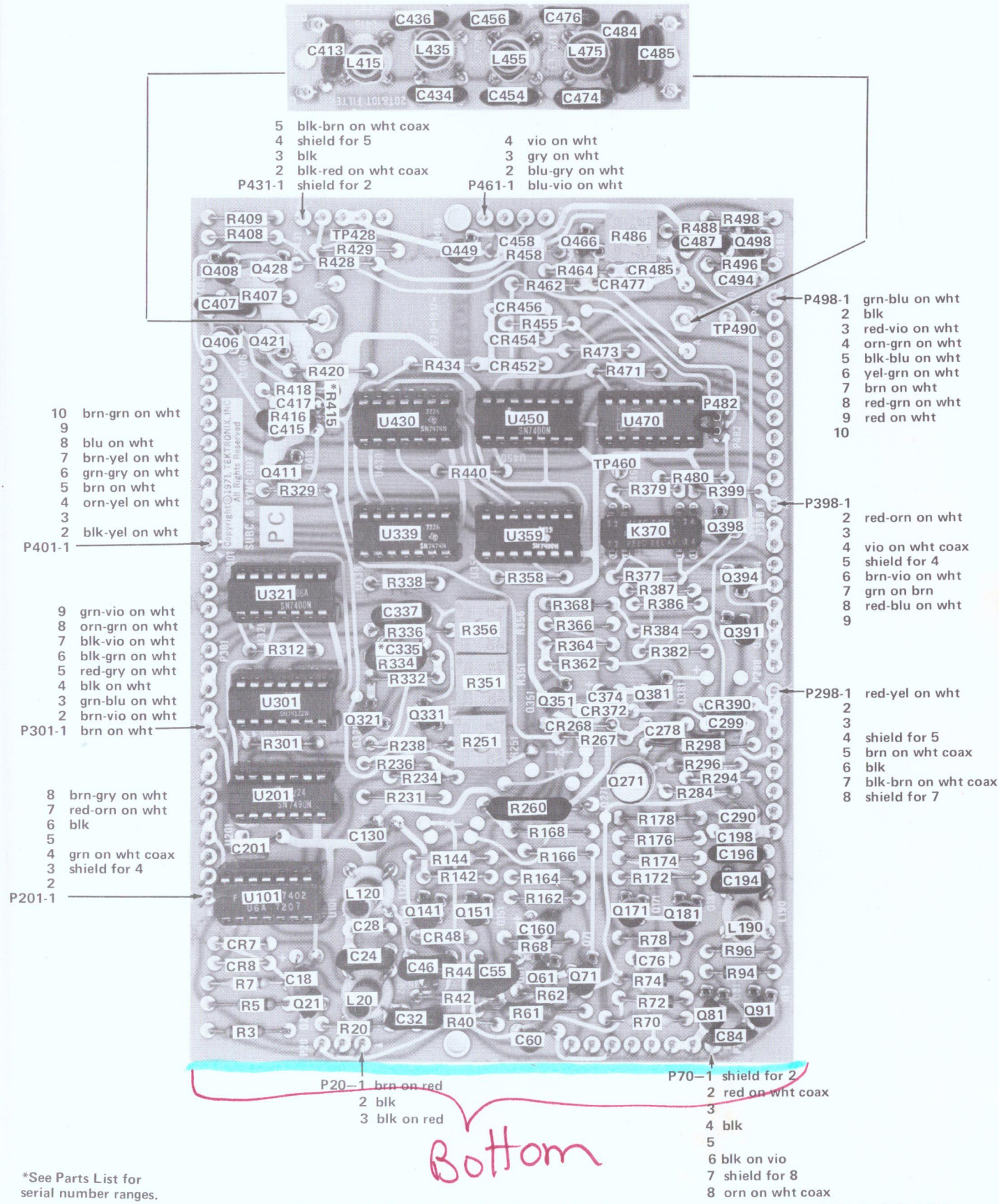






Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page.

0-500



*See Parts List for serial number ranges.

A9 – SUBCARRIER & SYNC OUT circuit board

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WAVEFORMS

SIN² PULSE GENERATOR

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

450pfd

+15V R498 33K C487 253 R464 180 Q466 A

P498 P2800-3 (2)b R496 3.3K Q498 C494 220 R488 15K +15V R486 10K SIN² PULSE GAIN CR485 +5V R462 2.2K CR477 B

C485 410 (SEL) L475 200-300µH L455 70-120µH L435 70-120µH L415 70-120µH C474 450 C484 1800 C454 430 C476 470 C434 170 C456 304 C436 430 C413 164

C D A14 20T FILTER

(2) TP428 R429 455 (SEL FOR 20T WIDTH)

P431 P8960-2 (8) P7193-1 (7)b

P401 P4960-6 (4) MODIFIED VERT. BLANKING

P1690-8 (1) VERT. BLANKING

TIME 3I P2630-4 (2)a

TIME I P2630-6 (2)a

S9280 ALT & 6 (12) R358 18K LOW FOR ALT & 6

S9280 ALL (12) P301 R338 18K LOW FOR ALL

S9260 FLAT FIELD (12) LOW FOR FLAT FIELD

S9275 VAR APL (12) LOW FOR PRESET + VAR APL

P2690-7 (2)b P4930-2 (4)

U339A 7474 U339B 7474 U430A 7474 U430B 7474

U359D ¼ 7400 U359C 7400 U359B 7400 U359A 7400

U450B 7400 U450D 7400 U450C 7400 U450A 7400

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
2. ALL IC'S: PIN 7 IS GROUNDED PIN 14 IS VCC, +5V

ALTERNATE SWITCHING LOGIC

+5V R473 1K CR456 CR452 LOW FOR WINDOW C438 100 (SEL) R434 10K -15V CR454 FULL FIELD ENABLE TP490 (4)

P461 59260 WINDOW (12) P4590-1 (4) P498 P4960-3 (4)

P461 P4960-7 (4) P4960-8 (4) ALT

FLAT FIELD LOGIC

P498 C458 100 R458 3.3K Q449 TP460 (3) R455 390 +5V

U470A 7451 U470B 7451 U450A 7400 R471 18K +5V

8 FLAT FIELD ENABLE P498 P3930-1 (3)b

MOD. PULSE ENABLE

U450C 7400 Q411 R440 10K LOW FOR FIELD SQ WAVE P401 P3801-1 (3)b

P/O A9 SUBCARRIER & SYNC OUT CIRCUIT BOARD

P498 P2800-1 (2)b

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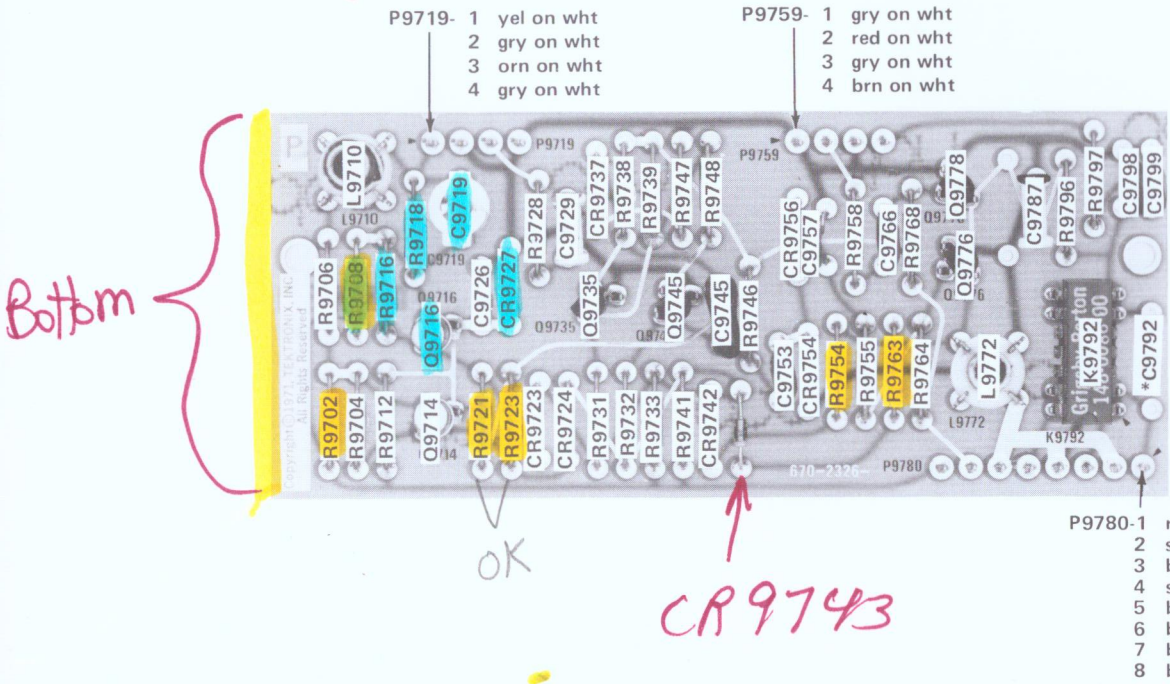
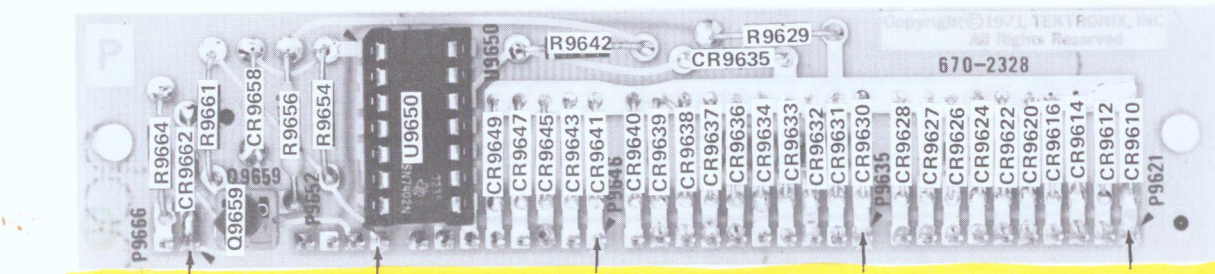
SIN² PULSE GEN & MODE SEQUENCE (9)b K/MEB

SIN² PULSE GEN & MODE SEQUENCE (9)b

9000



9000



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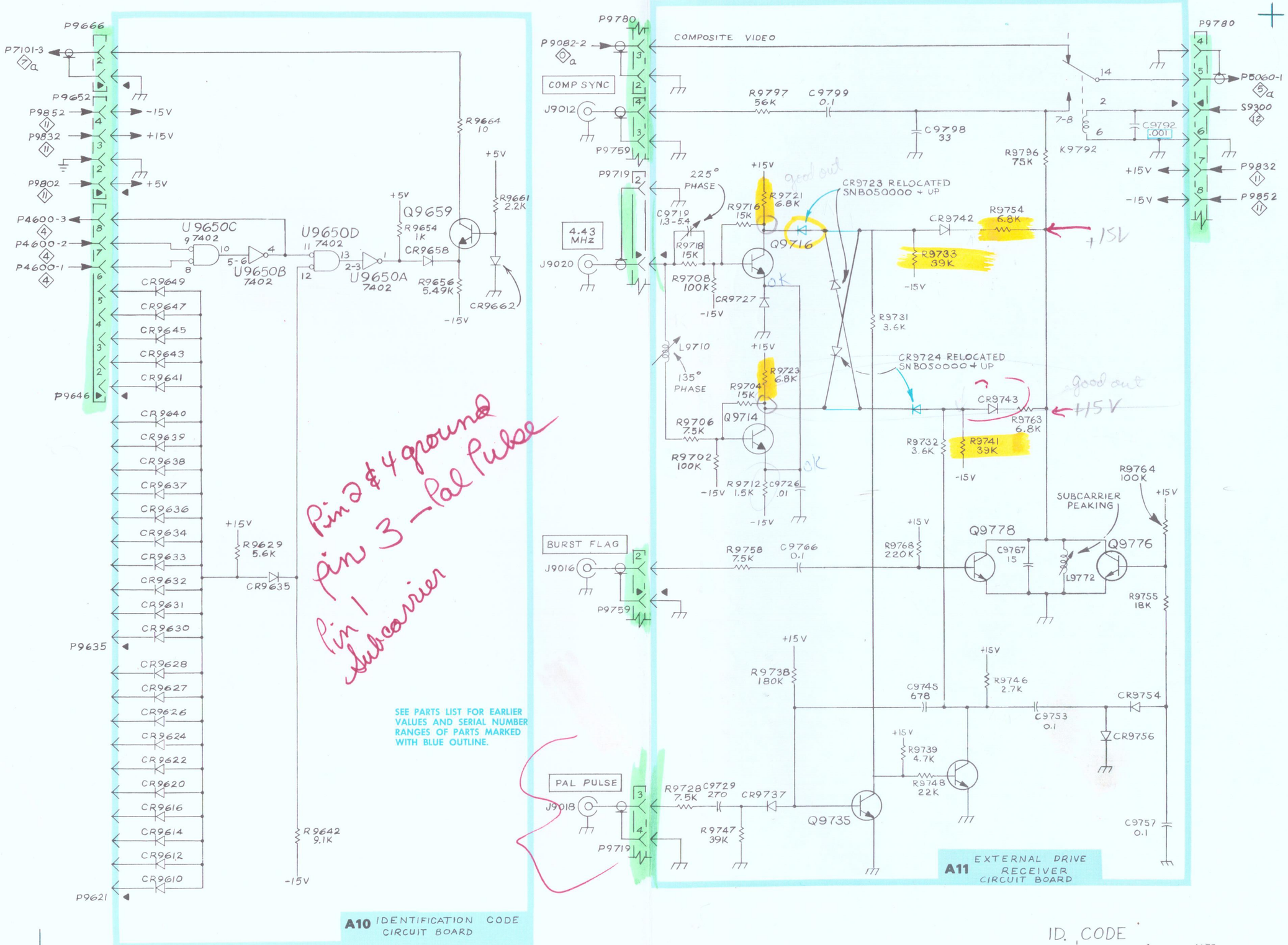
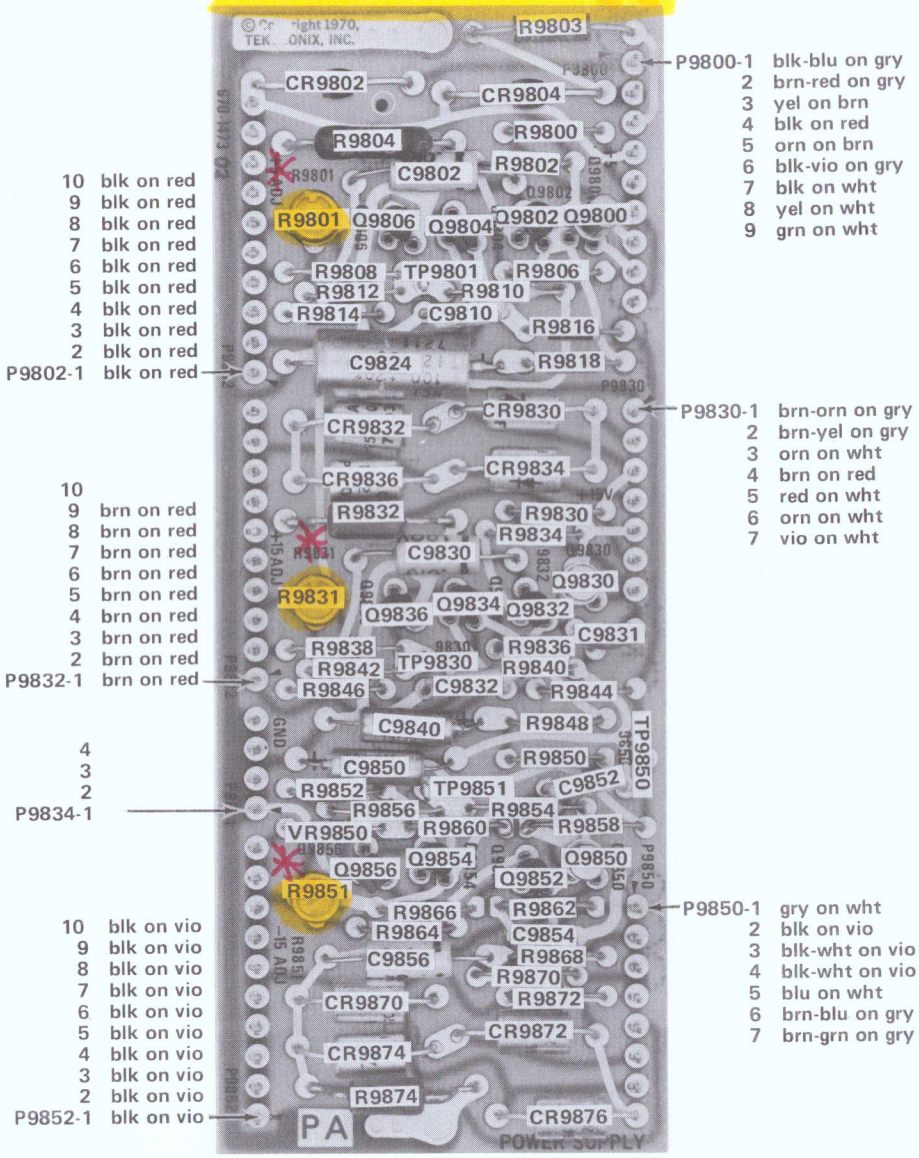
A10 – IDENTIFICATION CODE and
A11 – EXTERNAL DRIVE RECEIVER circuit board

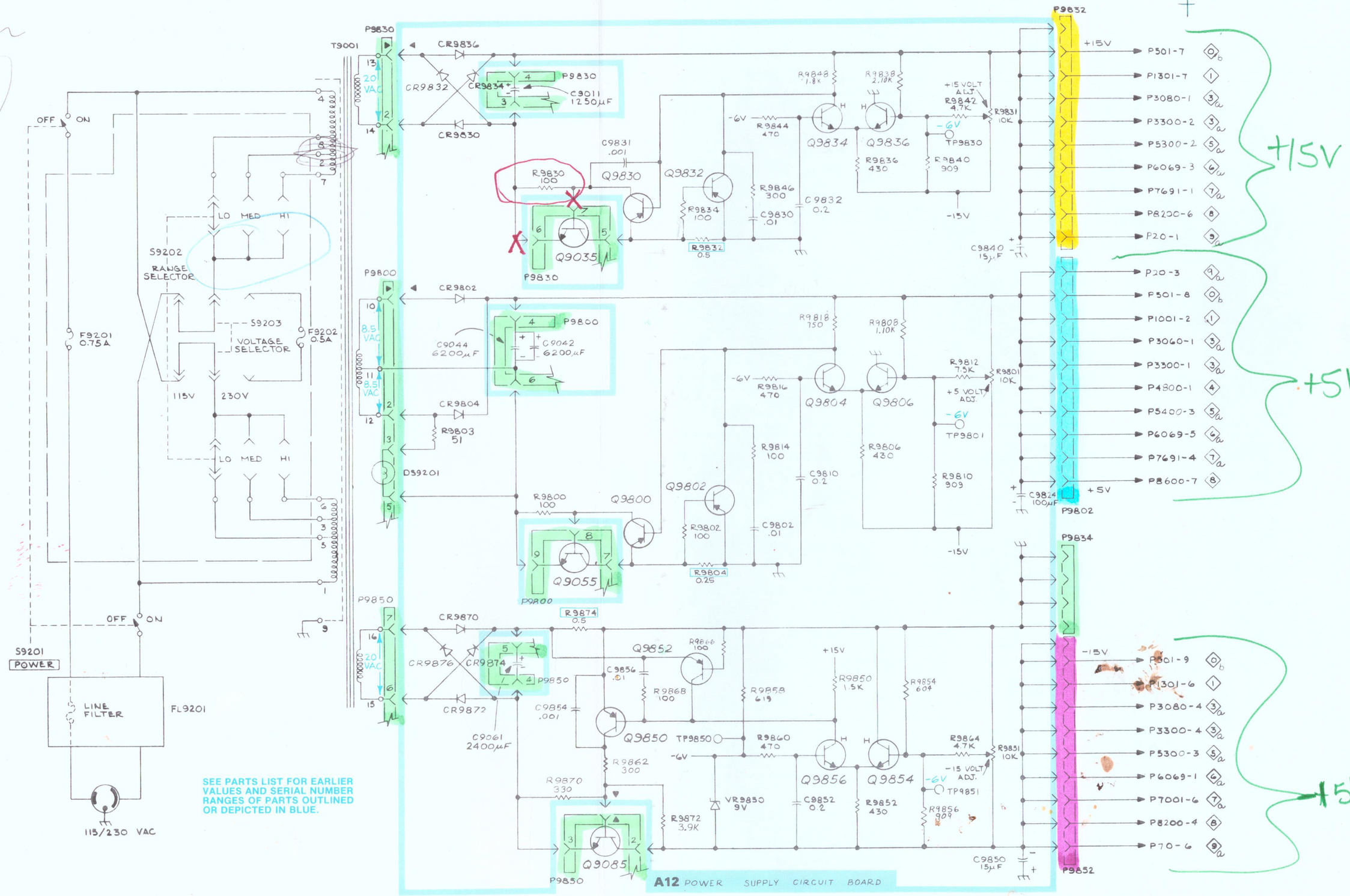

P9666
P7101-3
7a
P9652
P9852
11
-15V
P9832
11
+15V
P9802
11
+5V
P4600-3
4
P4600-2
4
P4600-1
4
U9650C
9 7402
10
5-6
8
U9650B
7402
4
U9650D
11 7402
13
12
2-3
U9650A
7402
1
+5V
Q9659
R9654
1K
CR9658
R9656
5.49K
-15V
R9664
10
+5V
R9661
2.2K
CR9662
P9646
CR9649
CR9647
CR9645
CR9643
CR9641
CR9640
CR9639
CR9638
CR9637
CR9636
CR9634
CR9633
CR9632
CR9631
CR9630
P9635
CR9628
CR9627
CR9626
CR9624
CR9622
CR9620
CR9616
CR9614
CR9612
CR9610
P9621
+15V
R9629
5.6K
CR9635
R9642
9.1K
-15V
Pin 2 & 4 ground
Pin 3 - Pal Pulse
Pin 1
Subcarrier
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
A10 IDENTIFICATION CODE CIRCUIT BOARD
P9780
P9082-2
6a
COMP SYNC
J9012
P9759
P9719
4.43 MHZ
J9020
BURST FLAG
J9016
P9759
PAL PULSE
J9018
P9719
COMPOSITE VIDEO
R9797
56K
C9799
0.1
C9798
33
14
7-8
2
6
K9792
C9792
.001
R9796
75K
P9780
5
P5060-1
5a
S9300
12
6
P9832
11
7
P9852
11
8
+15V
-15V
225°
PHASE
C9719
13-54
+15V
R9721
6.8K
good out
CR9723 RELOCATED
SN8050000 + UP
Q9716
R9716
15K
R9718
15K
R9708
100K
CR9727
-15V
OK
CR9742
R9754
6.8K
+15V
R9733
39K
-15V
R9731
3.6K
L9710
135°
PHASE
+15V
R9723
6.8K
CR9724 RELOCATED
SN8050000 + UP
good out
+15V
R9704
15K
Q9714
R9706
7.5K
R9702
100K
R9712
1.5K
C9726
.01
-15V
OK
CR9743
R9763
6.8K
R9732
3.6K
R9741
39K
-15V
R9764
100K
+15V
SUBCARRIER
PEAKING
Q9778
Q9776
C9767
15
L9772
R9768
220K
R9758
7.5K
C9766
0.1
R9755
18K
+15V
R9738
180K
C9745
678
+15V
R9746
2.7K
CR9754
C9753
0.1
CR9756
+15V
R9739
4.7K
R9748
22K
R9728
7.5K
C9729
270
CR9737
R9747
39K
Q9735
C9757
0.1
A11 EXTERNAL DRIVE RECEIVER CIRCUIT BOARD

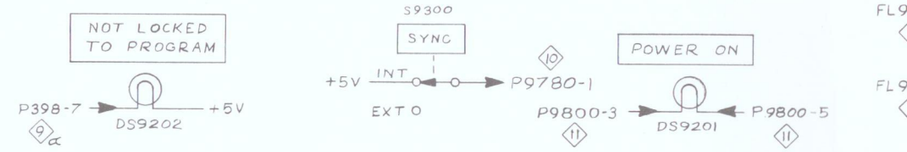
9000 Bottom

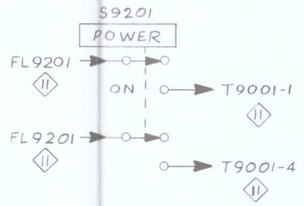


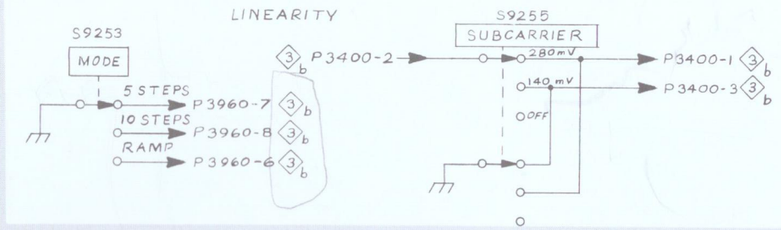
* Power Supply Adjust
+15V
-15V
+5V

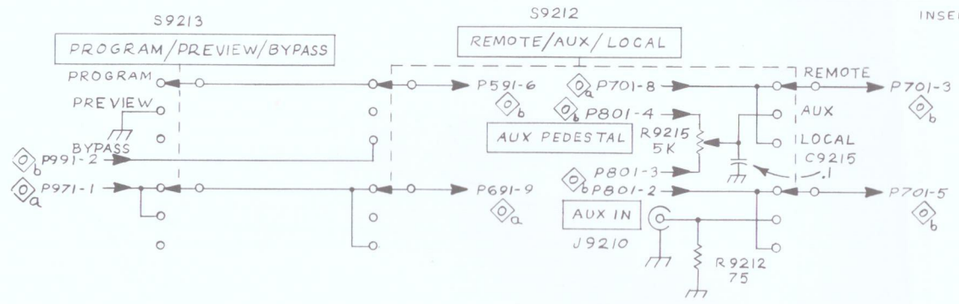
A12 – POWER SUPPLY circuit board

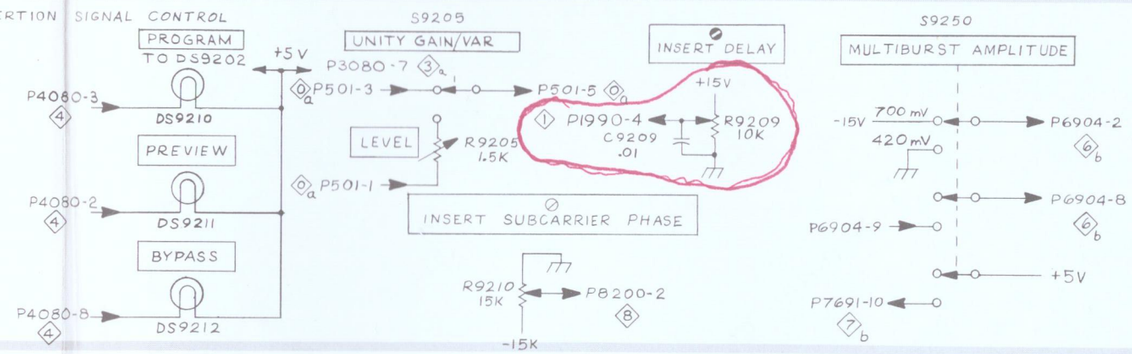

OFF ON
S9202
RANGE SELECTOR
LO MED HI
S9203
VOLTAGE SELECTOR
115V
230V
F9201 0.75A
F9202 0.5A
S9201 POWER
LINE FILTER
FL9201
115/230 VAC
T9001
20 VAC
8.5 VAC
8.51 VAC
20 VAC
P9830
P9800
P9850
P9832
P9802
P9834
P9852
CR9836
CR9832
CR9834
CR9830
C9011 1250µF
R9830 100
C9831 .001
Q9830
Q9832
R9834 100
R9832 0.5
C9830 .01
C9832 0.2
Q9035
R9844 470
R9848 1.8K
R9838 2.10K
Q9834
Q9836
R9836 430
R9840 909
+15 VOLT ADJ.
R9842 4.7K
R9831 10K
TP9830
-6V
-15V
C9840 15µF
+15V
P501-7
P1301-7
P3080-1
P3300-2
P5300-2
P6069-3
P7691-1
P8200-6
P20-1
CR9802
CR9804
C9044 6200µF
C9042 6200µF
R9803 51
D39201
R9800 100
Q9800
Q9802
R9802 100
R9804 0.25
C9802 .01
C9810 0.2
Q9055
R9816 470
R9818 750
R9808 1.10K
Q9804
Q9806
R9812 7.5K
R9801 10K
+5 VOLT ADJ.
TP9801
R9814 100
R9806 430
R9810 909
C9824 100µF
+5V
P20-3
P501-8
P1001-2
P3060-1
P3300-1
P4800-1
P5400-3
P6069-5
P7691-4
P8600-7
CR9870
CR9876
CR9874
CR9872
C9061 2400µF
R9874 0.5
C9854 .001
C9856 .01
Q9852
R9866 100
R9868 100
R9858 619
Q9850
TP9850
R9862 300
R9870 330
R9872 3.9K
VR9850 9V
Q9085
R9850 1.5K
R9854 604
Q9856
Q9854
R9860 470
R9864 4.7K
R9851 10K
-15 VOLT ADJ.
TP9851
R9856 909
C9852 0.2
R9852 430
C9850 15µF
-15V
P301-9
P1301-6
P3080-4
P3300-4
P5300-3
P6069-1
P7001-6
P8200-4
P70-6
+15V
+5V
-5V
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.
A12 POWER SUPPLY CIRCUIT BOARD

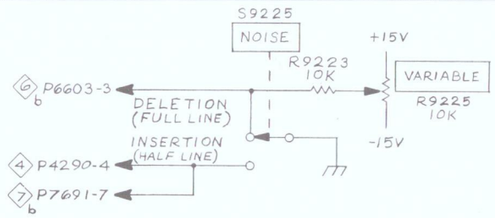


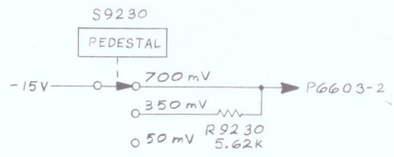




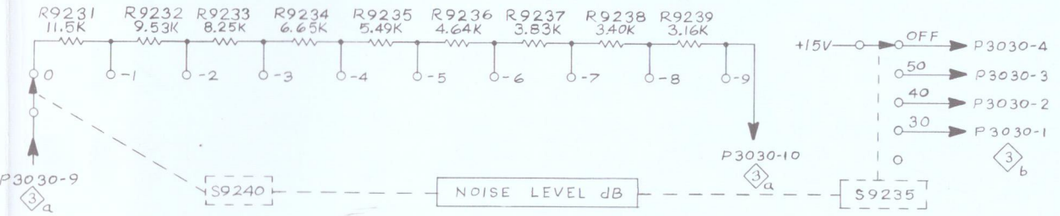




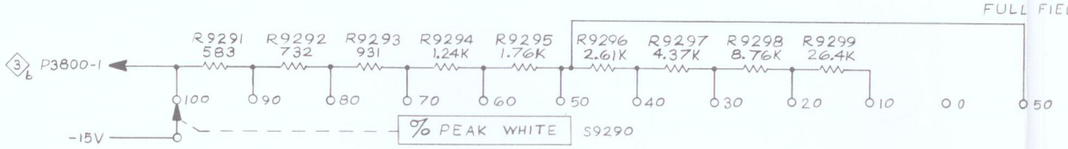


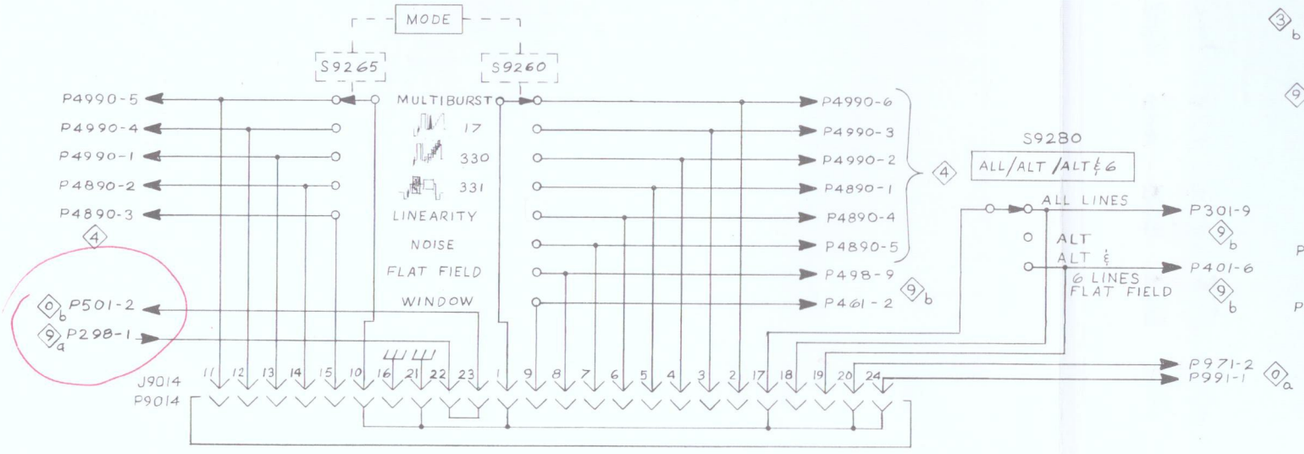


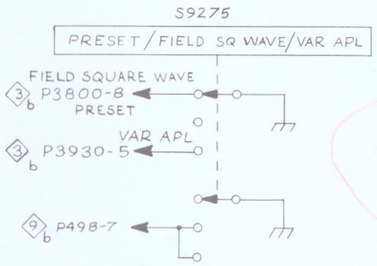
NOISE AND PEDESTAL

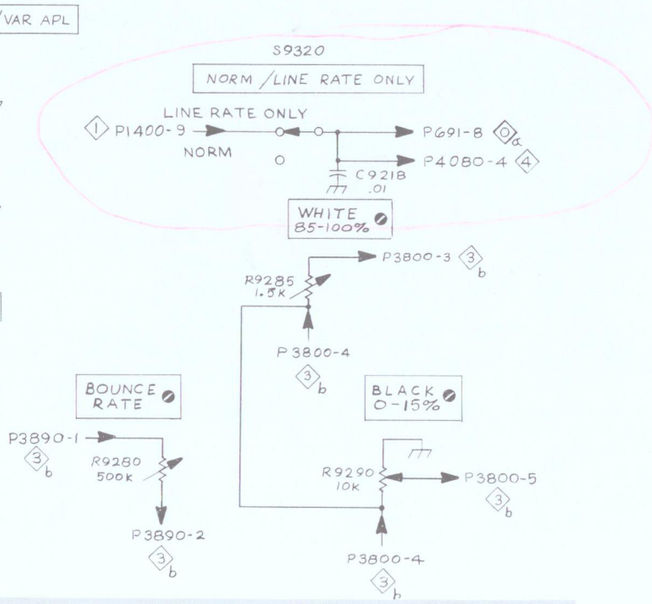


FULL FIELD SIG









REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
09422	PLASTIC STAMPING CORPORATION	2216 W. ARMITAGE AVE.	CHICAGO, IL 60647
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
46384	PENN ENGINEERING AND MFG. CORP.	P O BOX 311	DOYLESTOWN, PA 18901
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
77132	DOT FASTENER CO., A UNITED-CARR DIV. OF TRW INC.	ROUND HOUSE INDL PK,PO BOX 710	WATERBURY, CT 06720
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80033	PRESTOLE EVERLOCK, INC.	P. O. BOX 278,1345 MIAMI ST.	TOLEDO, OH 43605
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
91737	ITT CANNON GREMAR, INC.	922 S. LYON ST.	SANTA ANA, CA 92705
94222	SOUTHCO, INC.		LESTER, PA 19113

FIGURE 1 FRONT AND CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	366-0500-00			5		KNOB:GRAY,4 SIDED	80009	366-0500-00
	----- -----			-		. EACH KNOB INCLUDES:		
	213-0153-00			2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-2	366-1189-00			2		KNOB:GRAY	80009	366-1189-00
	----- -----			-		. EACH KNOB INCLUDES:		
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-3	366-0215-02			13		KNOB:LEVER SWITCH	80009	366-0215-02
-4	367-0102-00			2		HANDLE,BOW:	80009	367-0102-00
						(ATTACHING PARTS FOR EACH)		
-5	212-0004-00			2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-6	213-0216-00			2		THUMBSCREW:10-32 X 0.85 INCH LONG SST	80009	213-0216-00
						(ATTACHING PARTS FOR EACH)		
-7	354-0025-00			1		RING,RETAINING:0.181 INCH FREE ID	79136	5555-18
-8	210-0894-00			1		WASHER,NONMETAL:0.19 ID X 0.438" OD,PLSTC	09422	OBD
						- - - * - - -		
-9	124-0270-00			1		STRIP,TRIM:RIGHT	80009	124-0270-00
-10	124-0270-01			1		STRIP,TRIM:LEFT	80009	124-0270-01
-11	407-0510-00			2		BRACKET,ANGLE:	80009	407-0510-00
						(ATTACHING PARTS FOR EACH)		
-12	212-0004-00			2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-13	351-0104-00			1		SLIDE SECT.,DWR:PAIR	06666	C-720-2
						(ATTACHING PARTS)		
-14	212-0004-00			4		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-15	390-0309-00			1		COVER,CAL FXTR:	80009	390-0309-00
-16	355-0134-00			2		. STUD,TURNLOCK F:FLAT HEAD STEEL	94222	82-14-140-16
-17	355-0135-01			12		. STUD TURNLOCK F:OVH STEEL,FOR0.14" THK PNL	94222	82-11-140-16
-18	214-0389-00			14		. FSTNR,RETAINER:SPLIT RING	94222	82-32-101-17
-19	200-1394-00			1		DOOR,ACCESS:	80009	200-1394-00
-20	355-0135-01			1		. STUD TURNLOCK F:OVH STEEL,FOR0.14" THK PNL	94222	82-11-140-16
-21	214-0389-00			1		. FSTNR,RETAINER:SPLIT RING	94222	82-32-101-17
						(ATTACHING PARTS)		
-22	210-0586-00			3		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
						- - - * - - -		
-23	390-0063-00			1		COVER,CAL FXTR:BOTTOM	80009	390-0063-00
-24	355-0134-00			2		. STUD,TURNLOCK F:FLAT HEAD STEEL	94222	82-14-140-16
-25	355-0135-00			12		. STUD TURNLOCK F:OVH STEEL,FOR0.14" THK PNL	94222	82-11-140-16
-26	214-0389-00			14		. FSTNR,RETAINER:SPLIT RING	94222	82-32-101-17
-27	260-0834-00			1		SWITCH,TOGGLE:DPDT,5A,125VAC,0.25-40 THD	09353	7201SN260-834-1B
						(ATTACHING PARTS)		
-28	210-0562-00			2		NUT,PLAIN,HEX.:0.25-40 X 0.312 INCH,BBS	73743	2X20224-402
-29	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-30	----- -----			1		RES.,VAR:(SEE R9215 EPL)		
						(ATTACHING PARTS)		
-31	210-0590-00			2		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-32	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-33	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						- - - * - - -		
-34	----- -----			1		RESISTOR.,VAR:(SEE R9225 EPL)		
						(ATTACHING PARTS)		
-35	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-36	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-37	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						- - - * - - -		
-38	260-1252-00			1		SWITCH,ROTARY:1 SECT,5 POSN,45 DEG	80009	260-1252-00
						(ATTACHING PARTS)		
-39	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-40	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
						- - - * - - -		

FIGURE 1 FRONT AND CABINET (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-41	260-1251-00			1		SWITCH,ROTARY:1 SECT,10 POSN,30 DEG	80009	260-1251-00
						(ATTACHING PARTS)		
-42	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-43	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
						- - - * - - -		
-44	260-1388-00			1		SWITCH,ROTARY:LEFT SEL	80009	260-1388-00
						(ATTACHING PARTS)		
-45	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-46	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
						- - - * - - -		
-47	260-1250-00			1		SWITCH,ROTARY:	80009	260-1250-00
						(ATTACHING PARTS)		
-48	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-49	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
						- - - * - - -		
-50	260-1374-00			1		SWITCH,ROTARY:1 SECT,12 POSN,30 DEG	80009	260-1374-00
						(ATTACHING PARTS)		
-51	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-52	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
						- - - * - - -		
-53	333-1555-00			1		PANEL,FRONT:	80009	333-1555-00
-54	358-0301-00			5		BUSHING,SLEEVE:FOR 0.185 DIA HOLE,GRAY	80009	358-0301-00
-55	260-0731-00			1		SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
						(ATTACHING PARTS)		
-56	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-57	260-0731-00			1		SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-58	260-1375-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1375-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-59	260-1390-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1390-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-60	260-0731-00			1		SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-61	260-0621-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-62	260-1376-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1376-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-63	260-0621-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-64	260-1383-00			1		SWITCH,LEVER:1 SECT,2 POSN,30 DEG, NON-SH	80009	260-1383-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-65	260-0621-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		

FIGURE 1 FRONT AND CABINET (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-66	260-1389-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1389-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-67	260-0731-00			1		SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0731-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-68	260-0621-00			1		SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-0621-00
						(ATTACHING PARTS)		
	220-0413-00			2		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-69	200-0935-00			5		BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-70	378-0602-00			2		LENS,LIGHT:GREEN	80009	378-0602-00
-71	378-0602-01			1		LENS,LIGHT:AMBER	80009	378-0602-01
-72	378-0602-02			2		LENS,LIGHT:RED	80009	378-0602-02
-73	352-0157-01			5		LAMPHOLDER:BLACK PLASTIC	80009	352-0157-01
-74	----- -----			1		RESISTOR,VAR:(SEE R9205 EPL)		
						(ATTACHING PARTS)		
	213-0020-00			1		SETSCREW:6-32 X 0.125 INCH,HEX.SOC STL	70276	OBD
						- - - * - - -		
-75	366-0261-00			1		KNOB:0.312 OD X 0.406 INCH LONG	80009	366-0261-00
-76	131-0106-02			2		CONNECTOR,RCPT,:BNC	80009	131-0106-02
						(ATTACHING PARTS FOR EACH)		
-77	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-78	----- -----			1		RESISTOR,VAR:(SEE R9210 EPL)		
						(ATTACHING PARTS)		
-79	358-0409-00			1		BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
-80	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-81	210-0471-00			1		NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LONG	80009	210-0471-00
-82	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-83	----- -----			1		RESISTOR,VAR:(SEE R9209 EPL)		
						(ATTACHING PARTS)		
-84	358-0409-00			1		BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
-85	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-86	210-0471-00			1		NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LONG	80009	210-0471-00
-87	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-88	----- -----			1		RESISTOR,VAR:(SEE R9285 EPL)		
						(ATTACHING PARTS)		
-89	358-0422-00			1		BSHG,MACH.THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
-90	210-0046-00			2		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-91	220-0484-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH AL	80009	220-0484-00
						- - - * - - -		
-92	----- -----			1		RESISTOR,VAR:(SEE R9290 EPL)		
						(ATTACHING PARTS)		
-93	358-0422-00			1		BSHG,MACH.THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
-94	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-95	220-0484-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH AL	80009	220-0484-00
-96	210-0223-00			1		TERMINAL,LUG:0.25 INCH DIA,SE	86928	A313-136
						- - - * - - -		
-97	----- -----			1		RESISTOR,VAR:(SEE R9280 EPL)		
						(ATTACHING PARTS)		
-98	358-0422-00			1		BSHG,MACH.THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
-99	210-0046-00			2		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-100	220-0484-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH AL	80009	220-0484-00
						- - - * - - -		
-101	390-0307-00			1		PANEL,CAL FXTR:RIGHT SIDE	80009	390-0307-00
						(ATTACHING PARTS)		
-102	211-0538-00			10		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-103	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
-104	210-0457-00			11		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		

FIGURE 1 FRONT AND CABINET (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-105	----- -----			1		CKT BOARD ASSY:ID CODE(SEE A10 EPL)		
-106	131-0608-00			34		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-107	136-0220-00			1		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-108	136-0269-00			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
						(ATTACHING PARTS FOR CKT BD)		
-109	211-0116-00			2		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-110	384-0617-00			2		SPACER POST:0.375 L W/4-40 THD THRU,BRS	80009	384-0617-00
						- - - * - - -		
-111	390-0066-00			1		COVER,CAL FXTR:LEFT	80009	390-0066-00
						(ATTACHING PARTS)		
-112	211-0538-00			11		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-113	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
-114	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-115	210-0457-00			11		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-116	386-2194-00			1		SUBPANEL,FRONT:	80009	386-2194-00
						(ATTACHING PARTS)		
	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		

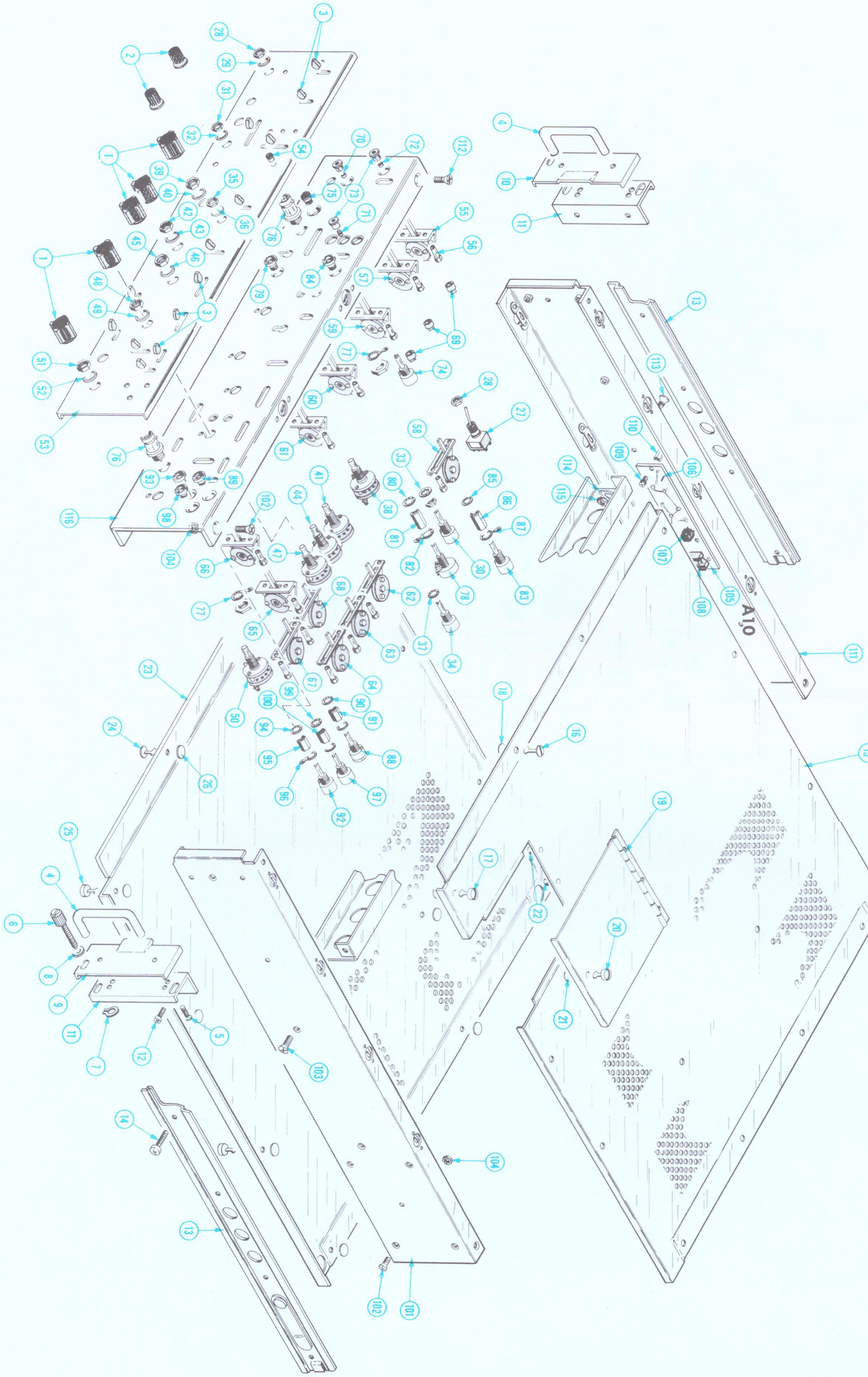


FIG. 1 FRONT & CABINET

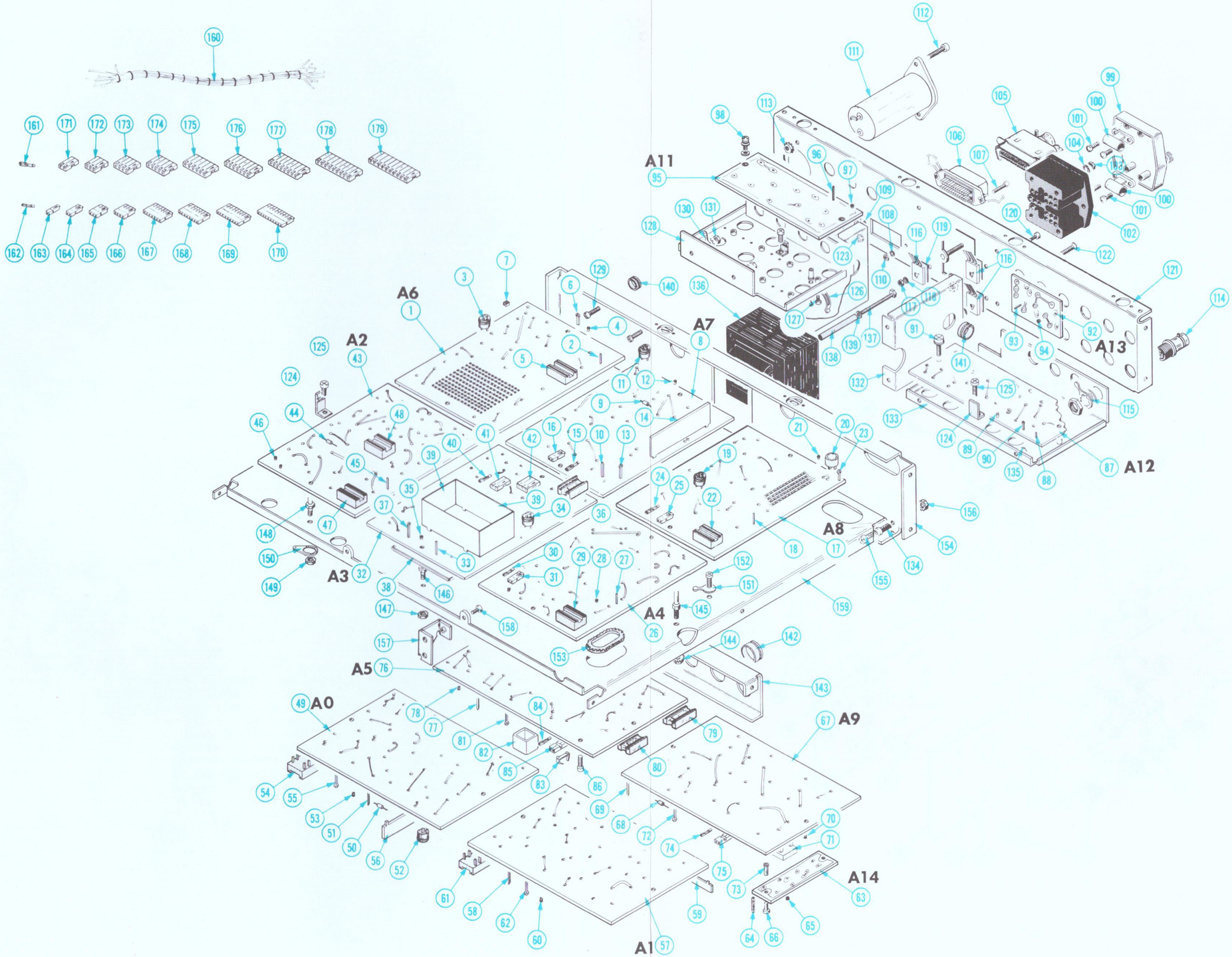

A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A11
A12
A13
A14

FIGURE 2 CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1		CKT BOARD ASSY:FUNCTION GEN(SEE A6 EPL)		
-2	131-0589-00			39		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			6		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-3	136-0235-00			2		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-4	136-0252-04			111		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-5	136-0269-00			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-6	214-0579-00			1		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-7	344-0108-00			8		. CLIP,ELECTRICAL:FOR 0.045" OD SEMICOND D	80009	344-0108-00
	200-0945-01	XB071250		1		COVER,HALF XSTR:FOR DUAL TO-18 CS,2-56 THD	80009	200-0945-01
						(ATTACHING PARTS)		
	211-0001-00	XB071250		1		SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	200-0945-00	XB071250		1		COVER,HALF XSTR:FOR DUAL TO-18 CASE	80009	200-0945-00
-8	----- -----			1		CKT BOARD ASSY:--OUTPUT AMP(SEE A7 EPL)		
-9	131-0566-00			1		. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	ERD-18T0
-10	131-0589-00			59		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	136-0608-00			9		. SKT,PL-IN ELEC:ELCTRN TUBE,14 CON W/LEADS	80009	136-0608-00
-11	136-0235-00			2		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-12	136-0252-04			74		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
	136-0352-00			36		. CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50872-2
-13	214-0579-00			3		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-14	337-1456-00			3		. SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-15	131-0707-00			6		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-16	131-0993-07			1		. LINK,TERM.CONNE:2 WIRE VIOLET	00779	530153-7
	131-0993-08			2		. LINK,TERM.CONNE:2 WIRE GRAY	00779	530153-8
-17	----- -----			1		CKT BOARD ASSY:--MODULATOR(SEE A8 EPL)		
-18	131-0589-00	B010100	B039999	46		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0589-00	B040000		49		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			10		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	214-0506-00			2		. CONTACT,ELEC:0.045 SQ X 0.375 INCH L	80009	214-0506-00
-19	136-0235-00			2		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-20	136-0241-00			1		. SOCKET,PLUG-IN:10 CONTACT,ROUND	71785	133-99-12-064
-21	136-0252-04	B010100	B039999	63		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
	136-0252-04	B040000		60		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
	136-0352-00			16		. CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50872-2
-22	136-0269-00			4		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-23	214-0579-00			2		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-24	131-0707-00	B010100	B039999	8		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	131-0707-00	B040000		10		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-25	131-0993-01			2		. LINK,TERM.CONNE:2 WIRE BROWN	00779	530153-9
	352-0169-03	B010100	B039999	1		. CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
	131-0993-03	B040000		2		. LINK,TERM.CONNE:2 WIRE ORANGE	00779	530153-3
-26	----- -----			1		CKT BOARD ASSY:--VIT FULL FIELD(SEE A4 EPL)		
-27	131-0589-00	B010100	B071249	84		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0589-00	B071250		72		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			232		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-28	136-0252-04			33		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-29	136-0269-00			18		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-30	131-0707-00			30		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-31	131-0993-00			1		. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
	131-0993-01			1		. LINK,TERM.CONNE:2 WIRE BROWN	00779	530153-9
	131-0993-02			1		. LINK,TERM.CONNE:2 WIRE RED	00779	1-530153-0
	131-0993-03			1		. LINK,TERM.CONNE:2 WIRE ORANGE	00779	530153-3
	131-0993-04			1		. LINK,TERM.CONNE:2 WIRE YELLOW	00779	530153-4
	131-0993-05			1		. LINK,TERM.CONNE:2 WIRE GREEN	00779	530153-5
	131-0993-06			1		. LINK,TERM.CONNE:2 WIRE BLUE	00779	530153-6
-32	----- -----			1		CKT BOARD ASSY:--APL STAIRCASE NOISE(SEE A3 EPL)		
-33	131-0608-00			79		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-34	136-0220-00			4		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-35	136-0252-04			87		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-36	136-0269-00			8		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-37	214-0579-00			4		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-38	337-1512-00			1		. SHLD,ELECTRICAL:CIRCUIT BOARD MOUNT	80009	337-1512-00

FIGURE 2 CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-39	337-1650-00			2	. SHIELD,ELEC:APL STAIRCASE NOISE	80009	337-1650-00
-40	131-0707-00			8	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-41	131-0993-00			1	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-42	352-0177-00			1	. CONN BODY,PL,EL:6 WIRE,DBL ROW BLACK	80009	352-0177-00
-43	----- -----			1	CKT BOARD ASSY:--HORIZONTAL TIMING(SEE A2 EPL)		
-44	131-0566-00			1	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	ERD-18T0
-45	131-0608-00			445	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-46	136-0252-04			48	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-47	136-0260-01			1	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-48	136-0269-00			19	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-49	----- -----			1	CKT BOARD ASSY:--VIT INSERTION(SEE A0 EPL)		
-50	131-0566-00			3	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	ERD-18T0
-51	131-0589-00			66	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			6	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-52	136-0235-00			1	. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-53	136-0252-04			96	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-54	136-0260-01			2	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-55	214-0579-00			7	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-56	337-1456-00			1	. SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-57	----- -----			1	CKT BOARD ASSY:--VERTICAL COUNTER(SEE A1 EPL)		
-58	131-0589-00			45	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-59	131-0998-00			5	. BUS BAR:9 TERM,8.132"LONG,CUT TO FIT	80009	131-0998-00
-60	136-0252-04			63	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-61	136-0269-00			18	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-62	214-0579-00			7	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-63	----- -----			1	CKT BOARD ASSY:--20 T FILTER(SEE A14 EPL)		
-64	136-0263-03	B010100	B070989	4	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B070990		4	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-65	136-0352-00			16	. CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50872-2
					(ATTACHING PARTS FOR CKT BD)		
-66	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-67	----- -----			1	CKT BOARD ASSY:--SUBCARRIER SYNC(SEE A9 EPL)		
-68	131-0566-00			1	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	ERD-18T0
-69	131-0589-00			74	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0590-00			4	. CONTACT,ELEC:0.71 INCH LONG	22526	47351
	131-0608-00			3	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-70	136-0252-04			83	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-71	136-0269-00			9	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-72	214-0579-00			4	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-73	361-0094-00			2	. SPACER,STANDOFF:4-40 X 0.25,SELF CLINCHING	46384	SOA-440-8
-74	131-0707-00			2	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-75	131-0993-02			1	. LINK,TERM.CONNE:2 WIRE RED	00779	1-530153-0
-76	----- -----			1	CKT BOARD ASSY:--GEN LOCK(SEE A5 EPL)		
-77	131-0589-00			23	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			3	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-78	136-0252-04			231	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
	136-0234-00			2	. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-79	136-0260-01			1	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-80	136-0269-00			1	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-81	214-0579-00			15	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-82	337-1417-00			1	. SHLD,ELECTRICAL:0.55 SQ X 0.685 INCH HIGH	80009	337-1417-00
-83	352-0096-00			1	. CLIP,SPR,TNSN:CRYSTAL	80009	352-0096-00
-84	131-0707-00			2	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-85	131-0993-06			1	. LINK,TERM.CONNE:2 WIRE BLUE	00779	530153-6
					(ATTACHING PARTS FOR CKT BD)		
-86	211-0116-00			4	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-87	----- -----			1	CKT BOARD ASSY:--POWER SUPPLY(SEE A12 EPL)		
-88	131-0589-00			57	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-89	136-0252-04			36	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-90	214-0579-00			4	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00

FIGURE 2 CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-	200-0945-01	XB071250		2		. COVER,HALF XSTR:FOR DUAL TO-18 CS,2-56 THD	80009	200-0945-01
						(ATTACHING PARTS FOR EACH)		
	211-0001-00	XB071250		1		. SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	200-0945-00	XB071250		2		. COVER,HALF XSTR:FOR DUAL TO-18 CASE	80009	200-0945-00
						(ATTACHING PARTS FOR CKT BD)		
-91	211-0116-00			2		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-92	----- -----			1		CKT BOARD ASSY:--RELAY(SEE A13 EPL)		
-93	131-0589-00			8		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-94	136-0252-04			8		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-95	----- -----			1		CKT BOARD ASSY:--EXTERNAL DRIVE(SEE A11 EPL)		
-96	131-0589-00			16		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-97	136-0252-04			26		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
						(ATTACHING PARTS FOR CKT BD)		
-98	211-0116-00			2		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	210-1014-00			1		WASHER,NONMETAL:0.094 ID X 0.312" OD,TEFLON	80009	210-1014-00
						- - - * - - -		
-99	200-0762-00			1		COV ASSY,LINE V:WITH FUSEHOLDER,115/230V	80009	200-0762-00
-100	352-0102-00			2		. FUSEHOLDER:0.262"ID TUBE FOR CRTG FUSE	80009	352-0102-00
						(ATTACHING PARTS FOR EACH)		
-101	213-0088-00			2		. SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-102	204-0279-00			1		BODY ASSY,LINE:115/230 VOLTS	80009	204-0279-00
						(ATTACHING PARTS)		
-103	210-0407-00			2		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-104	210-0006-00			2		WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
						- - - * - - -		
-105	131-0325-00			1		CONNECTOR,PLUG,:MALE,24 PIN	71785	57-30240(398)
-106	131-0324-00			1		CONNECTOR,RCPT,:24 PIN,FEMALE	71785	57-40240(398)
						(ATTACHING PARTS)		
-107	211-0062-00			2		SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
-108	210-0001-00			1		WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-109	210-0201-00			1		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
-110	210-0405-00			2		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
-111	----- -----			1		LINE FILTER:(SEE FL9201 EPL)		
						(ATTACHING PARTS)		
-112	211-0507-00	B010100	B071209	2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0586-00	B071210		2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
	211-0012-00	B071210		2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
	210-0202-00	XB071210		1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-113	210-0457-00	B010100	B071209	2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-114	131-0126-00			18		CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	131-0126-00	B071050		14		CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
						(ATTACHING PARTS FOR EACH)		
-115	210-0241-00			1		TERMINAL,LUG:0.515 ID X 0.625 INCH OD SE	80009	210-0241-00
						- - - * - - -		
	134-0156-00	B071050		4		BUTTON,PLUG:0.5 HOLE	77132	SS48152-K1110
-116	----- -----			3		TRANSISTOR:(SEE Q9035,Q9055,Q9085 EPL)		
						(ATTACHING PARTS FOR EACH)		
-117	210-0407-00			1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-118	210-0006-00			1		WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
-119	342-0163-00			1		INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-120	211-0538-00			1		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-121	386-2369-00	B010100	B071209	1		PANEL,REAR:	80009	386-2369-00
	386-2369-01	B071210		1		PANEL,REAR:R148/M	80009	386-2369-01
						(ATTACHING PARTS)		
-122	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-123	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		

FIGURE 2 CHASSIS (CONT)

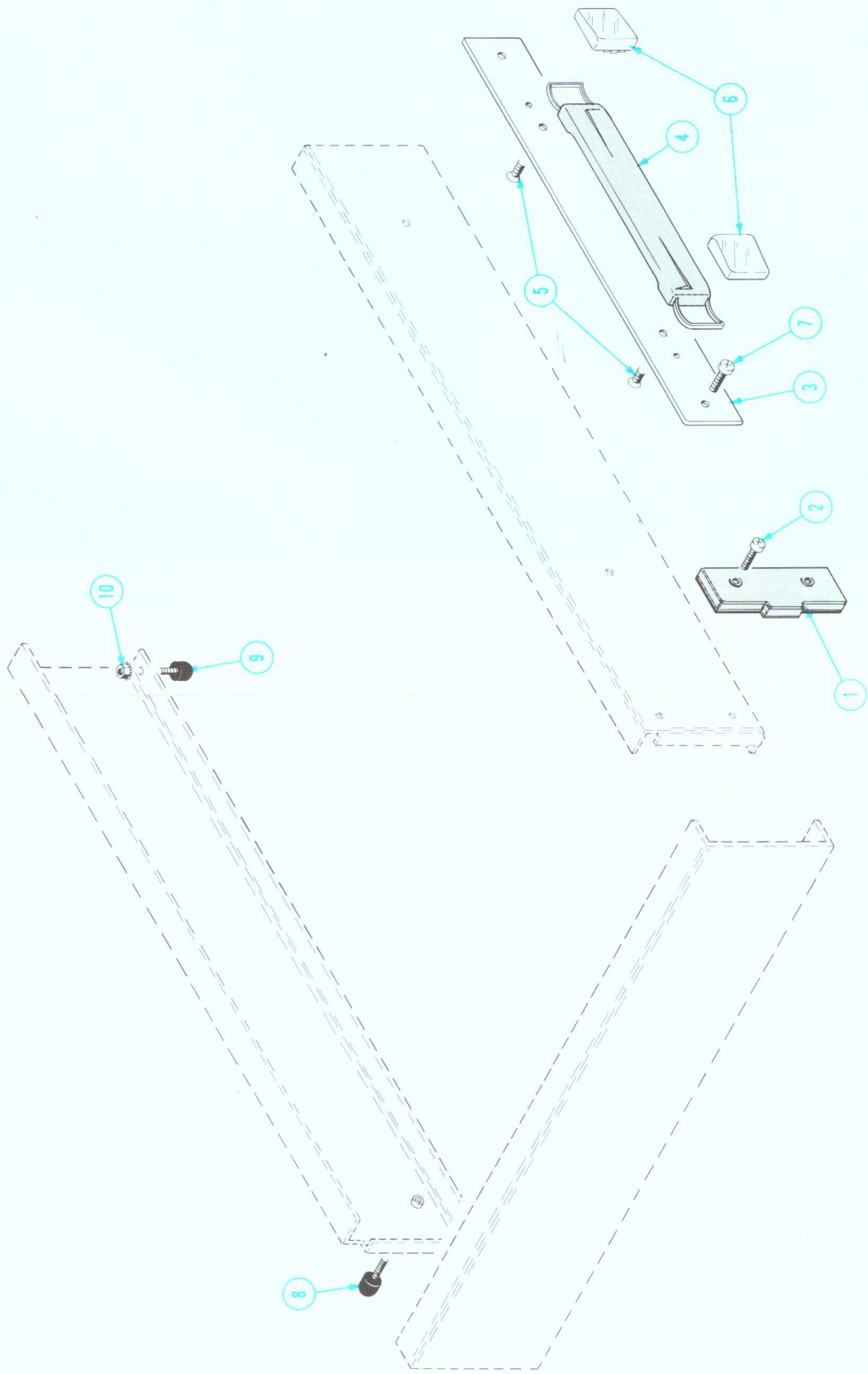
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-124	344-0133-00			50		CLIP,SPR,TNSN:CIRCUIT BOARD MOUNTING	80009	344-0133-00
						(ATTACHING PARTS FOR EACH)		
-125	213-0138-00			1		SCR,TPG,THD FOR:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-126	344-0016-00			8		RTNR,CAPACITOR:0.859 ID X 0.937 INCH H	80033	E50007041
						(ATTACHING PARTS FOR EACH)		
-127	211-0007-00			1		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-128	441-1062-00			1		CHASSIS,SIG GEN:PHASE SHIFT	80009	441-1062-00
						(ATTACHING PARTS)		
-129	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-130	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-131	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-132	386-1487-00			2		BRACKET,XFMR:	80009	386-1487-00
						(ATTACHING PARTS FOR EACH)		
	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-133	441-0892-00			1		CHAS,ELEC EQPT:OVEN CKT BOARD	80009	441-0892-00
						(ATTACHING PARTS)		
-134	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-135	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-136	----- -----			1		TRANSFORMER:(SEE T9001 EPL)		
						(ATTACHING PARTS)		
-137	212-0516-00			4		SCREW,MACHINE:10-32 X 2 INCH,HEX HD STL	77250	OBD
-138	166-0227-00			4		INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
-139	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	OBD
	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
						- - - * - - -		
-140	348-0063-00			4		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-141	348-0064-00			1		GROMMET,PLASTIC:0.625 INCH DIA	80009	348-0064-00
-142	348-0050-00			7		GROMMET,PLASTIC:0.75 INCH DIA	80009	348-0050-00
-143	386-1532-00			1		SUPPORT,CHASSIS:	80009	386-1532-00
						(ATTACHING PARTS)		
-144	210-0457-00			3		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-145	214-1169-00			3		PIN,GUIDE:0.80 INCH LONG	80009	214-1169-00
						- - - * - - -		
-146	214-1621-00			7		PIN,GUIDE:0.74 INCH LONG	80009	214-1621-00
						(ATTACHING PARTS FOR EACH)		
-147	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-148	214-1621-00			8		PIN,GUIDE:0.74 INCH LONG	80009	214-1621-00
						(ATTACHING PARTS FOR EACH)		
-149	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-150	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
						- - - * - - -		
-151	210-0201-00			7		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
						(ATTACHING PARTS FOR EACH)		
-152	213-0044-00			1		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-153	255-0334-00			1		PLASTIC CHANNEL:	11897	122-37-2500
-154	407-0555-00			1		BRACKET,XFMR:	80009	407-0555-00
						(ATTACHING PARTS)		
-155	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-156	210-0457-00			3		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-157	386-2195-00			2		SUPPORT,CHASSIS:	80009	386-2195-00
						(ATTACHING PARTS FOR EACH)		
-158	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
						- - - * - - -		

FIGURE 2 CHASSIS (CONT)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-159	441-1050-00			1		CHASSIS,SIG GEN:MAIN	80009	441-1050-00
-160	179-1768-00	B010100	B039999	1		WIRING HARNESS:CHASSIS	80009	179-1768-00
	179-1768-01	B040000		1		WIRING HARNESS:MAIN	80009	179-1768-01
-161	131-0621-00	B010100	B039999	256		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46233
	131-0621-00	B040000		254		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46233
	131-0792-00			36		. CONTACT,ELEC:0.577"L,18-20 AWG WIRE	22526	46221
-162	131-0707-00			119		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	131-0708-00			7		. CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
-163	352-0171-00			1		. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
	352-0171-02			1		. CONN BODY,PL,EL:1 WIRE RED	80009	352-0171-02
	352-0171-03			3		. CONN BODY,PL,EL:1 WIRE ORANGE	80009	352-0171-03
	352-0171-04			2		. CONN BODY,PL,EL:1 WIRE YELLOW	80009	352-0171-04
-164	352-0169-00			2		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-165	352-0161-00			3		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
-166	352-0162-00			4		. CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
-167	352-0165-00			3		. CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0165-00
-168	352-0166-00			8		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
-169	352-0167-00			2		. CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0167-00
-170	352-0168-00			3		. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-171	352-0198-00			10		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0198-00
-172	352-0199-00	B010100	B039999	5		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	352-0199-00	B040000		7		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-173	352-0200-00			8		. CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0200-00
-174	352-0201-00			4		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-175	352-0202-00	B010100	B039999	2		. CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0202-00
	352-0202-00	B040000		1		. CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0202-00
-176	352-0203-00			1		. CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0203-00
-177	352-0204-00			9		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-178	352-0205-00			7		. CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
-179	352-0206-00			13		. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0206-00
	179-1860-00			1		WIRING HARNESS:COAX	80009	179-1860-00
	131-0621-00			15		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46233
	131-0622-00			7		. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	352-0199-00			2		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	352-0201-00			1		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	179-1861-00			1		WIRING HARNESS:POWER	80009	179-1861-00
	131-0621-00			21		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46233
	352-0203-00			2		. CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0203-00
	352-0205-00			1		. CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
	179-1862-00			1		WIRING HARNESS:HORIZ TIMING	80009	179-1862-00
	131-0707-00			125		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	352-0165-00			1		. CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0165-00
	352-0166-00			4		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
	352-0166-03			3		. CONN BODY,PL,EL:8 WIRE ORANGE	80009	352-0166-03
	352-0167-00			2		. CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0167-00
	352-0168-00			1		. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
	352-0169-00			1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0171-00			25		. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
	352-0171-01			18		. CONN BODY,PL,EL:1 WIRE BROWN	80009	352-0171-01
	352-0171-02			13		. CONN BODY,PL,EL:1 WIRE RED	80009	352-0171-02
	352-0171-03			6		. CONN BODY,PL,EL:1 WIRE ORANGE	80009	352-0171-03
	179-1864-00			1		WIRING HARNESS:AC	80009	179-1864-00

FIGURE 3 BENCH MODEL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	124-0216-00			2		STRIP,TRIM:CORNER	80009	124-0216-00
						(ATTACHING PARTS FOR EACH)		
-2	212-0068-00			2		SCREW,MACHINE:8-32 X 0.312 INCH,TRH STL	77250	OBD
						- - - * - - -		
	386-1663-00			1		PLATE,HDL MTG:	80009	386-1663-00
-3	386-1663-01			1		. PLATE,HDL MTG:	80009	386-1663-01
-4	367-0037-00			1		. HANDLE,CARRYING:	12136	5340-00-083-0430
						(ATTACHING PARTS)		
-5	212-0506-00			2		. SCREW,MACHINE:10-32 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-6	344-0098-00			2		. CLIP,DECORATIVE:	12136	5340-00-469-6192
						(ATTACHING PARTS)		
-7	212-0507-00			2		SCREW,MACHINE:10-32 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-8	348-0048-00			4		FOOT:W/6-32 X 0.350 INCH STUD	80009	348-0048-00
-9	348-0048-00			4		FOOT:W/6-32 X 0.350 INCH STUD	80009	348-0048-00
						(ATTACHING PARTS FOR EACH)		
-10	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		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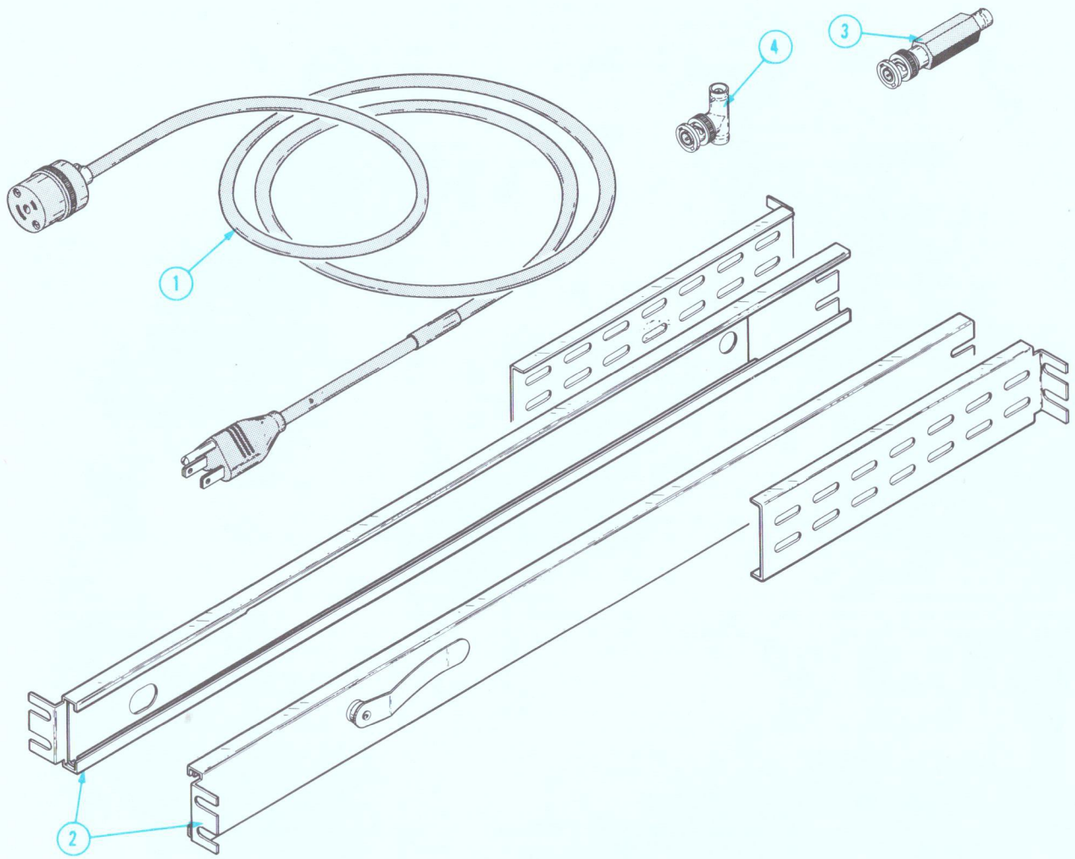

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	161-0036-00	B010100	B071209	1		CABLE ASSY,PWR:3,18 AWG,115V,90.0L	80009	161-0036-00
	161-0066-00	B071210		1		CABLE ASSY,PWR,:3 WIRE,98 INCH LONG	80009	161-0066-00
-2	351-0195-00			1		SLIDE,DWR,EXT:SLIDE,PAIR(RACKMOUNT ONLY)	06666	C719
-3	011-0103-02			1		TERMN,COAXIAL:75 OHM,BNC	80009	011-0103-02
-4	103-0030-00			2		ADAPTER,CONN:BNC TO BNC	91737	UG274BUDURAPLATE
	070-1266-00			1		MANUAL,TECH:INSTRUCTION	80009	070-1266-00

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

REV. A, OCT 1975

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committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT 148 & 148M
070-1266-00 & 070-1807-00

CHANGE REFERENCE M32779
DATE 12-14-77

CHANGE:	DESCRIPTION

EFF SN B081510 (148) 070-1266-00

EFF SN B020154 (148M) 070-1807-00

EFF SN B081426 (R148 950B & 950A)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

K9080 148-0107-04 RELAY,ARMATURE:W/8 PIN HEADER

K9080 is located on the RELAY circuit board assembly and shown on diagram 0_a PROGRAM LINE AMPLIFIER.